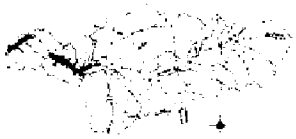
Comprehensive Nutrient Management Plan

Prepared by the Eucha / Spavinaw
Watershed Management Team



Operation Overview
Title page
- Driving directions
- Legal Description

CNMP - Signature page
CNMP Introduction
Farm overview
Operation and Maintenance

Maps and Soil Information
Aerial map with buffered sensitive areas
Topographic maps
Soil maps
Non-technical soil descriptions

Current Year Litter Application Plan
Nutrient allocation plan and application map
Commercial fertilizer recommendations
Soil and litter analysis
ESPI
Pasture Phosphorus Management Calculator
Nutrient Balance
Exported manure schedule

Record Keeping Documents
Litter applied
Litter sold or given away
Commercial fertilizer applied

Appendices
Litter spreader calibration calculations
Animal outputs
RUSLE and hydrologic condition defined
NRCS Conservation Practice Standards
Previous years application plans

Eucha/Spavinaw Watershed Management Team
P.O. Box 248
Decatur, AR 72722

Comprehensive Nutrient Management Plan

For:

Da and Tia Yang
54296 Co Rd 593
Colcord, OK 74338
Phone: (479) 220-7484

Directions to farm: From Kansas, OK.
From intersection of scenic 412 and Hwy 10 go one mile north on Hwy 10; turn left or west on county road E550 and go 2 miles west to county road N 4600; turn right and go north on N 4600 which turns into county road 593; go 1.4 miles to driveway on left

Poultry house location: Poultry houses are located at: Latitude 36° 14' 2" N; Longitude 94° 49' 15.9" W; in the SE ¼ of Section 2, Township 20 North, Range 23 East and the NW ¼ of NE ¼ of Section 11, Township 20 North, Range 23 East.

Field locations: Fields contained within this plan are at 1 location in: Sections 2 and 11, T20N R23W

Watershed: All fields are contained within the Spavinaw Creek Watershed (HUC 11070209). This watershed is designated as a Nutrient Surplus Area.

Prepared by: Eucha Spavinaw Watershed Management Team
PO Box 248
Decatur, AR 72722
Phone: (479) 752-5705

Eucha/Spavinaw Watershed Management Team
P.O. Box 248
Decatur, AR 72722

CNMP Signature Page

PRIOR TO SPREADING ANY POULTRY LITTER OR CAKE IN THE WATERSHED, YOU OR YOUR SPREADER MUST CONTACT JOHN EVERETT 48 HOURS IN ADVANCE AT 479-752-5701.

The following individuals have assisted in the development of this CNMP and certify their elements meet the settlement agreement requirements as well as applicable local / state / federal standards.

Nutrient Management Planner

Name: Lagenna Williams _____ Number: _____

Title: CNMP Certified Planner

Signature Lagenna Williams Date: 11-22-06

Farm Owner / Manager

A representative of the Eucha Spavinaw Watershed Management Team has discussed the contents of this plan with me. I understand that nutrient management on my farm within the Eucha Spavinaw Watershed must be in accordance with the guidelines presented in this plan.

Signature: Date: 11.22.06

CNMP Introduction

WATER QUALITY & HEALTH ISSUES

Eutrophication of surface waters has increased public awareness of water quality and placed a national emphasis on controlling contributing human activities. While eutrophication is a natural aging process, it can be markedly accelerated by human activities that lead to excessive nutrient loading of surface waters. This accelerated eutrophication restricts water use for fisheries, recreation, industry, and drinking water due to increased growth of aquatic weeds and undesirable algae. The presence of cyanobacteria (blue-green algae) in drinking water can also pose a very serious health hazard to humans and wildlife. As these algal blooms die and are decomposed by bacteria, such as actinomycetes, geosmine compounds are produced that give drinking water a foul taste. Also of concern is the possible production of trihalomethanes, potential carcinogens, in public drinking water supplies due to chlorination of eutrophic waters high in organic carbon. Health concerns related to eutrophication are prompting government agencies, municipalities, and industry to implement policy changes concerning the management of nutrients within a given watershed.

Phosphorus is the nutrient that poses the greatest potential for accelerating eutrophication. Because other nutrients required by algae are more available in nature, phosphorus often acts as the limiting nutrient in freshwater systems. Although sources of phosphorus in runoff vary, one potentially large source of runoff is from soils having excessive phosphorus levels. Long-term manure applications based on meeting the nitrogen needs of crops have resulted in excessive levels of phosphorus accumulating in the soil due to the ratio of N:P (nitrogen to phosphorus) required by the plant being greater then the N:P ratio found in manure. Also of significant concern is the amount of soluble phosphorus that exists in the manure itself. This soluble fraction of phosphorus is highly prone to transport in runoff water and is immediately available for uptake by algae and other aquatic plants.

PLAN INTENT

Due to these environmental quality concerns, land application of poultry litter will be based upon the phosphorus content in the soil and in the poultry litter to be applied.

This comprehensive nutrient management plan is site-specific for this farm, which gives litter application recommendations for each field. It incorporates conservation practices and management activities, which will ensure that both agriculture production and environmental protection goals are achieved. The producer should be aware that other

beneficial management practices might be available to improve sustainability of the production operation, and discussions of such with a Team member are encouraged.

PLAN REQUIREMENTS

This plan was developed to meet the requirements of both the Arkansas and Oklahoma Nutrient Management 590 Standards and the lawsuit settlement agreement between the City of Tulsa and The Tulsa Metropolitan Utility Authority vs. Tyson Foods Inc., Cobb-Vantress Inc., Peterson Farms Inc., Simmons Foods Inc., Cargill Inc., and Georges Inc. Poultry litter or commercial phosphorus cannot be applied to any fields on this farm within the Eucha Spavinaw watershed without a plan from the Eucha Spavinaw Watershed Management Team. Any changes to this plan must be approved by a Team representative and must be documented in the Record Keeping Section. It is understood that farm management is a dynamic process; therefore a representative of the Team will update this plan annually in an attempt to assess variables impacting your management and assist you in addressing those issues.

Farm Overview

LOCATION AND TOPOGRAPHY

The setting for this operation is in Delaware County, OK within the Eucha Spavinaw Watershed, which consists of the Cherokee prairies in the northern part and the Ozark highlands in the southern part. The soils are a mixture of silt loam, gravelly silt loam, and cherty silt loam. The landscape varies from pastureland, hayland, and wildlife land with scattered timber along the riparian areas. Delaware County has an average daily high temperature of 72 degrees and low of 48 degrees. The average annual precipitation is 43 inches with approximately 60 percent of the precipitation falling during the crops growing season between April and September.

Because of the limestone parent material of many of the soils in the county, there are several areas of karst topography which can contain sinkholes and shallow soils over fractured bedrock. In these areas there is a greater potential to pollute ground water with surface applied nutrients.

DESCRIPTION OF OPERATION

This plan includes the production, handling, and distribution of waste from 4 hen houses. The houses are 40 feet wide and 400 feet long with a total capacity of 10,000 birds per house. Birds are grown from 20 weeks of age to 60 weeks of age with a market weight of approximately 8 lbs. On an average, there will be one flock per year for a total yearly production of about 40,000 birds.

Total litter production is estimated to be 500 tons per year. Clean out of litter is planned for once a year. Litter is applied to lands that are included in this plan, and surplus is sold to landowners with a current waste management plan or sold to haulers that transport outside the watershed. The litter is spread on the surface of the ground on pastureland and hay meadows. If weather conditions are not favorable at time of cleanout, litter is stored and protected in a manner to prevent overhead water from displacing the litter from the storage area.

There are approximately 67.5 spreadable acres of land on this farm which can potentially receive litter applications. Of these acres, all are owned by the operator. The crops grown are Bermuda grass and tall fescue.

A couple sensitive areas exist in or near the fields contained within this plan. There is an intermittant stream between two fields and a couple of ponds on the property. Litter should not be spread within 100' of the ponds or streams.

Operation and Maintenance

ANIMAL MORTALITY

Normal animal mortality is managed daily by collection of the dead animals and disposal of the carcasses in an incinerator. Composting and freezing and hauling to a rendering plant are also acceptable methods of dealing with mortality.

In case of catastrophic loss, the Oklahoma State Department of Agriculture (ODA) may approve the use of a pit for disposal of large quantities of dead birds. This pit must be no less than four feet in depth, and must be covered with dirt and lime on a daily basis. An alternate method is in-field composting. To ensure that your disposal actions are legal, ODA should be contacted prior to dealing with catastrophic loss.

COMPOST

Organic wastes generated by a composting facility does not fall under the definition of poultry waste as defined by the terms of the settlement agreement or current interpretation of applicable state laws. Therefore the application rates are not governed by the Eucha Spavinaw Phosphorus Index or any other applicable state index. However, application of composted poultry should conform to the Best Management Practices contained within this plan and/or in accordance to NRCS Conservation Practice Standards 590, Nutrient management and 633, Waste Utilization (see Appendices).

A dead poultry composter should be maintained by the criteria as defined in the NRCS Practice Standard 317. Composting is a biological process that requires a combination of art and science for success. Hence, the operation may need to undergo some trial and error in the start-up and management of a composting facility.

LITTER STORAGE

Poultry litter accumulates and is stored within the poultry houses. A full house cleanout is usually required after every flock.

When land application of poultry waste cannot occur immediately upon cleanout, due to weather or some other circumstance, litter should be stored so as to prevent rainwater from dispersing the litter. If storage is needed, the litter should be piled and tarped in an elevated location.

LAND APPLICATION

Lands with acceptable P1 values can receive litter upon cleanout of the poultry houses. Litter is surface applied using a truck mounted box spreader or a pull-behind wagon spreader.

SPREADER CALIBRATION

Proper calibration of spreader equipment is essential to ensure the amount of litter applied is within the required guidelines to protect water quality. The two methods of calibration that are generally used are 1) calibration based on equipment settings and operational conditions and 2) calibration based on tons per load and number of loads applied. Guidelines for each of these methods of calibration are included in the Appendices of this plan.

Applicators should be certified by a state recognized program or be under the direct supervision of a certified applicator.

LAND TREATMENT PRACTICES

Nutrient Management- Poultry litter and commercial fertilizer will be applied to land to help meet crop nutrient needs. Poultry litter will be applied based on the application rates calculated from the Eucha Spavinaw Phosphorus Index as ordered by the court in Case No. CV 0900EA(C) U.S. District Court, Northern District of Oklahoma.

Nutrient application rate recommendations are based on a nutrient budget for N, P, and K. A nutrient crop budget identifies:

(a) The amount of nutrients required to achieve a realistic yield goal,
(b) The amount of nutrients provided to the crops by residual nitrogen and previous manure applications,
(c) The amount of nutrients supplied by poultry litter,
(d) The amount of nutrients supplied by grazing cattle, and
(e) The amount of nutrients that should be supplied by commercial fertilizer

Soil testing, manure analysis, and record keeping will be performed according to this plan.

Waste Utilization- Waste will be spread by any method that will result in uniform application of material at specified rates. Maintain a manure non-application buffer of 100 feet from rock outcrops, streams, ponds, lakes, springs, sinkholes, wells, and any other water supplies. These non-application buffer areas are marked on the litter application maps.

Applications in flood prone areas should not be made during flooding season. Applications of waste are not to be made on frozen or snow covered ground, when the soil is saturated, during rainy weather, or when significant rainfall is anticipated within the next 24 hours. Litter should be distributed as evenly as possible. Litter should not be applied to actively eroding areas, on shallow soils (less than 10 inches deep), on slopes with grades in excess of 15 percent, on stony areas, or in any manner that will allow litter to enter the waters of the state.

Forage Management- Cutting and removal of hay will be at a frequency and height that will maintain a desired healthy plant community.

Pest Management- Will manage infestations of insects, weeds, and diseases to reduce adverse impacts on plant growth and crop production.

SOIL AND LITTER SAMPLING

As required by the settlement agreement, soil and litter sampling must be performed by a member of the Watershed Management Team. Samples will be taken using the guidelines recommended by university and extension personnel. Samples will be taken annually before litter is spread.

BEST MANAGEMENT PRACTICES

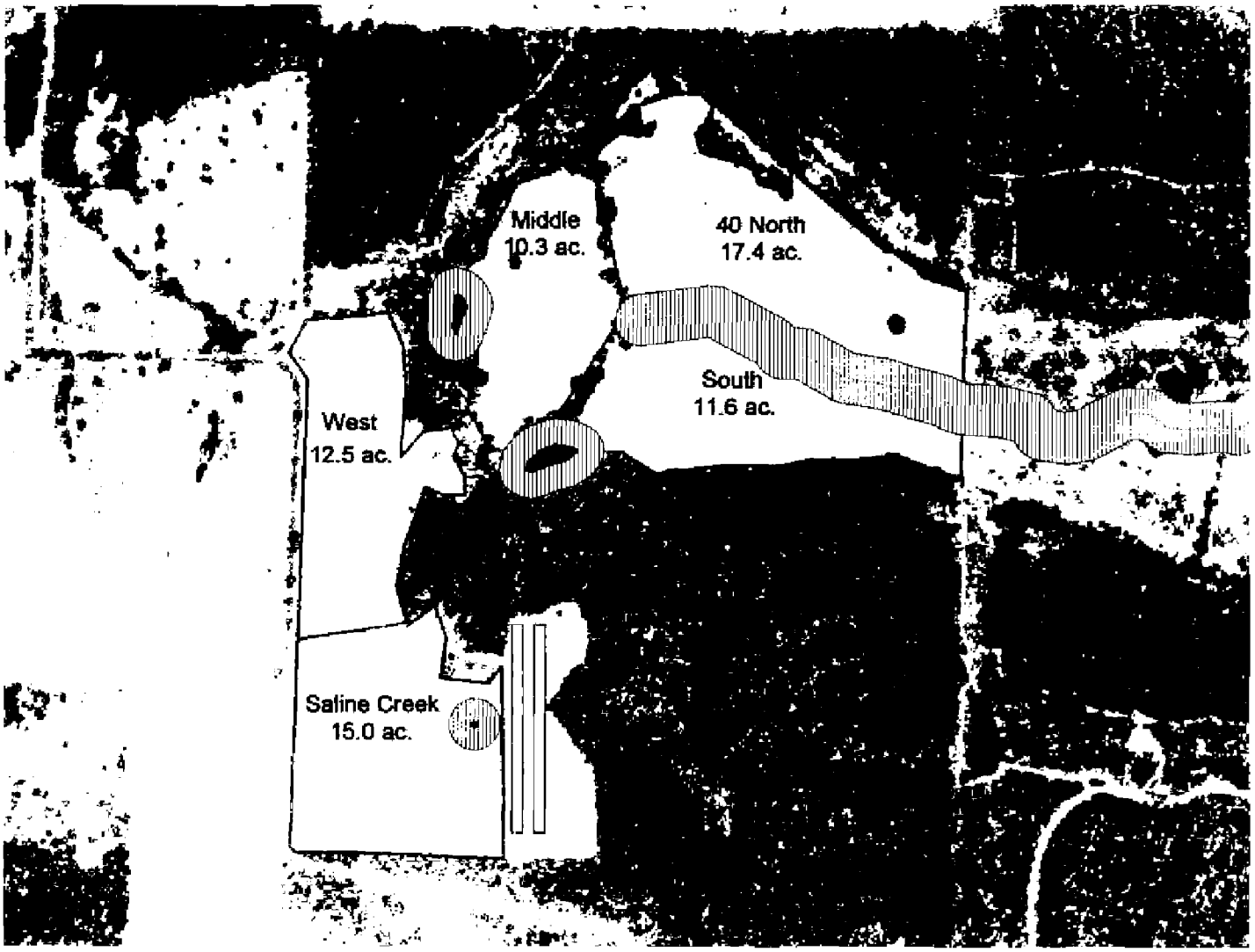
Best Management Practices (BMP's) when properly constructed or applied constitute the conservation system necessary to protect the natural resources and meet planning objectives. Apply and maintain each practice according to the type of operation and intended use of the land.

1. Apply litter not to exceed amounts given in this CNMP or a revised recommendation based on new soil and litter test.
2. Obtain new soil and litter test every year.
3. Secure enough soil tests to adequately represent the conditions on your farm.
4. Maintain a good growth of grass at all times, preferably not less than 4 inches tall. This reduces runoff, erosion, and nutrient loss.
5. Control weeds and brush to maintain a good stand of grass.
6. Apply litter during the growth cycle of the forage crop being grown. The growth cycle will normally be in the spring or fall for cool season forages and spring to summer for warm season forages.
7. Prescribed grazing may be used to maintain forage heights, reduce erosion and runoff, and protect water quality
8. Maintain filter strips in buffer zones around environmentally sensitive areas.

ODOR RECOMMENDATIONS

Avoid spreading litter when the wind will blow toward populated areas. Avoid spreading just before weekends and holidays when people are more likely to be outdoors. Spread litter in the morning when the air is warming and rising, rather than in the late afternoon. Consider weather conditions, sunny low humid days reduce odor; turbulent breezes will dilute and dissipate odors.

Tia and Da's Farm Aerial/Buffer Map
S2 & 11 T20N R23E



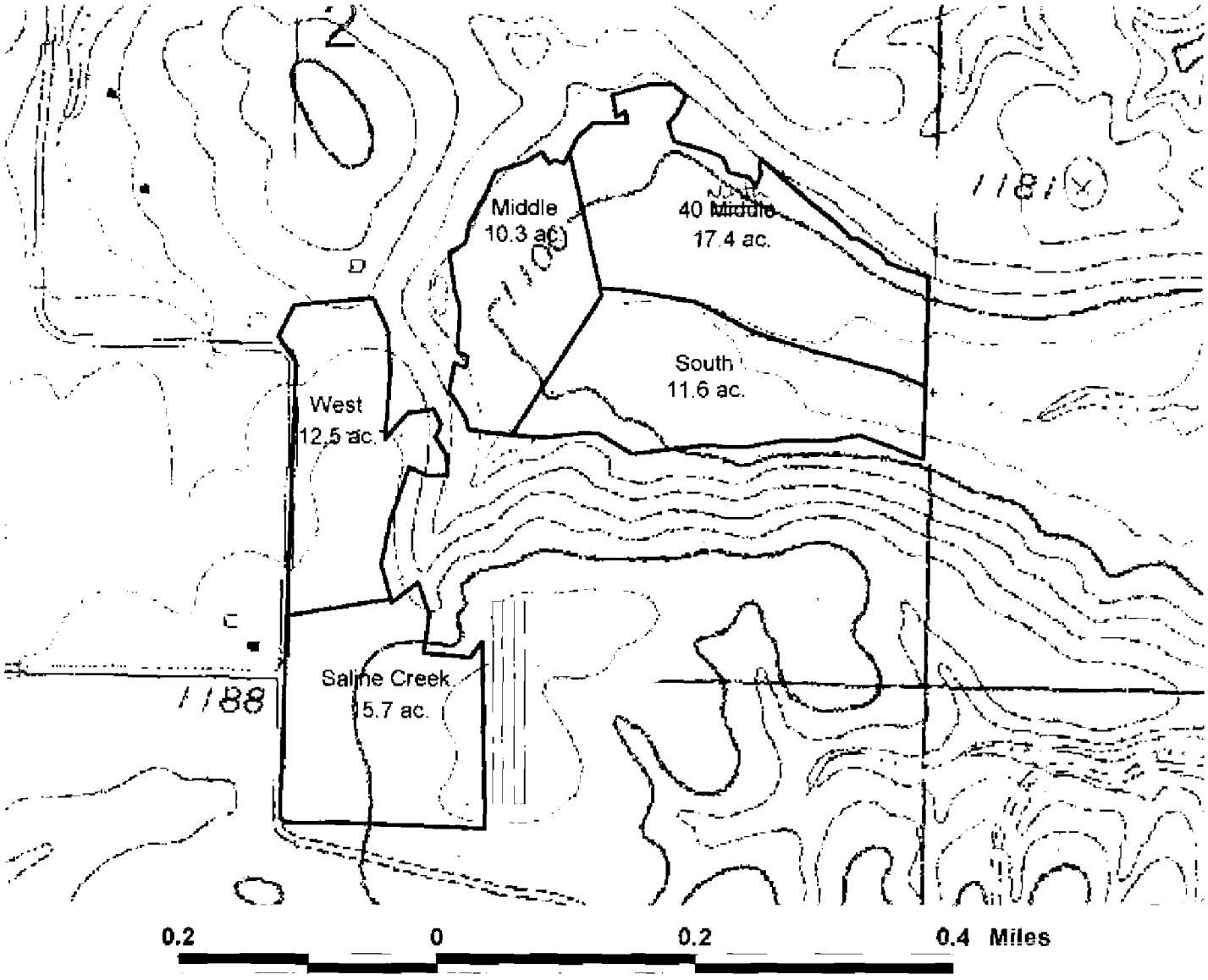
0.2 0 0.2 0.4 Miles

N
W E
S

- Well
- 100' Buffer of Well
- Pond
- 100' Buffer of Pond
- Streams
- 100' Buffer of Streams
- Fields
- Chickenhouses

Yang-Da.pdf ESWM 009106

Tia and Da's Farm Topographic Map



Yang-Da.pdf

ESWM 009107

Non-Technical Descriptions

Delaware County, Oklahoma

[Only those map units that have entries for the selected non-technical description categories are included in this report]

Map unit: BcB - Macedonia silt loam, 1 to 3 percent slopes

Description category: SOI

MACEDONIA SILT LOAM IS MORE THAN 60 INCHES DEEP WITH A LIGHTER COLORED SURFACE LAYER AND SLOPES OF 2-3 PERCENT. AVAILABLE WATER CAPACITY IN INCHES: 5.1-7.8; MAJOR CONSIDERATIONS: NONE; LANDUSE MAY INCLUDE: CROPLAND, WOODLAND; LAND CAPABILITY CLASS: 2E.

Map unit: BtC - Doniphan-Tonti complex, 3 to 5 percent slopes

Description category: SOI

DONIPHAN IS MORE THAN 60 INCHES DEEP WITH A LIGHTER COLORED SURFACE LAYER AND SLOPES OF 3-5 PERCENT. AVAILABLE WATER CAPACITY IN INCHES: 4.0-5.4; MAJOR CONSIDERATIONS: NONE; LANDUSE MAY INCLUDE: CROPLAND, WOODLAND; LAND CAPABILITY CLASS: 4S.

Description category: SOI

TONTI GRAVELLY SILT LOAM IS MORE THAN 60 INCHES DEEP WITH A LIGHTER COLORED SURFACE LAYER AND SLOPES OF 3-5 PERCENT. AVAILABLE WATER CAPACITY IN INCHES: 4.2-7.4; MAJOR CONSIDERATIONS: WATER TABLE; LANDUSE MAY INCLUDE: CROPLAND, WOODLAND; LAND CAPABILITY CLASS: 3E.

Map unit: CkD - Clarksville very gravelly silt loam, 1 to 8 percent slopes

Description category: SOI

CLARKSVILLE IS MORE THAN 60 INCHES DEEP WITH A LIGHTER COLORED SURFACE LAYER AND SLOPES OF 1-8 PERCENT AVAILABLE WATER CAPACITY IN INCHES: 3.5-5.8; MAJOR CONSIDERATIONS: NONE; LANDUSE MAY INCLUDE: CROPLAND, WOODLAND; LAND CAPABILITY CLASS: 4S

Map unit: CtE - Clarksville stony silt loam, 5 to 20 percent slopes

Description category: SOI

CLARKSVILLE STONY SILT LOAM IS MORE THAN 60 INCHES DEEP WITH A LIGHTER COLORED SURFACE LAYER AND SLOPES OF 5-20 PERCENT. AVAILABLE WATER CAPACITY IN INCHES: 3.5-5.8; MAJOR CONSIDERATIONS: SLOPE; LANDUSE MAY INCLUDE: WOODLAND; LAND CAPABILITY CLASS: 6S.

Map unit: CtF - Clarksville stony silt loam, 20 to 50 percent slopes

Description category: SOI

CLARKSVILLE STONY SILT LOAM IS MORE THAN 60 INCHES DEEP WITH A LIGHTER COLORED SURFACE LAYER AND SLOPES OF 20-50 PERCENT. AVAILABLE WATER CAPACITY IN INCHES: 3.5-5.8; MAJOR CONSIDERATIONS: SLOPE; LANDUSE MAY INCLUDE: WOODLAND; LAND CAPABILITY CLASS: 7E.

Map unit: LoB - Tonti gravelly silt loam, 1 to 3 percent slopes

Description category: SOI

TONTI GRAVELLY SILT LOAM IS MORE THAN 60 INCHES DEEP WITH A LIGHTER COLORED SURFACE LAYER AND SLOPES OF 1-3 PERCENT. AVAILABLE WATER CAPACITY IN INCHES: 3.3-5.2; MAJOR CONSIDERATIONS: WATER TABLE; LANDUSE MAY INCLUDE: CROPLAND, WOODLAND; LAND CAPABILITY CLASS: 2E.

Non-Technical Descriptions

Delaware County, Oklahoma

Map unit: SgD - Britwater gravelly silt loam, 3 to 8 percent slopes

Description category: SOI

BRITWATER GRAVELLY SILT LOAM IS MORE THAN 60 INCHES DEEP WITH A LIGHTER COLORED SURFACE LAYER AND SLOPES OF 3-8 PERCENT. AVAILABLE WATER CAPACITY IN INCHES: 5.9-9.9; MAJOR CONSIDERATIONS: NONE; LANDUSE MAY INCLUDE: RANGELAND, WOODLAND; LAND CAPABILITY CLASS: 3E.

Map unit: Sn - Razort gravelly loam, 0 to 3 percent slopes, occasionally flooded

Description category: SOI

RAZORT GRAVELLY LOAM IS MORE THAN 60 INCHES DEEP WITH A LIGHTER COLORED SURFACE LAYER AND SLOPES OF 0-3 PERCENT. AVAILABLE WATER CAPACITY IN INCHES: 6.4-10.3; MAJOR CONSIDERATIONS: FLOODING; LANDUSE MAY INCLUDE: RANGELAND, WOODLAND; LAND CAPABILITY CLASS: 2W.

Water Features (K1)

Delaware County, Oklahoma

[Depths of layers are in feet. Estimates of the frequency of ponding and flooding apply to the whole year rather than to individual months. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Map symbol and soil name	Hydrologic group	Month	Water table		Ponding			Flooding	
			Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
			Ft	*Ft*	*Ft*				
BcB:									
Macedonia	B	Jan-Dec			---	---	None	---	None
BIC:									
Doniphan	B	Jan-Dec			---	---	None	---	None
Tonti	C	January	1.5-2.5	2.0-5.0	---	---	None	---	None
		February	1.5-2.5	2.0-5.0	---	---	None	---	None
		March	1.5-2.5	2.0-5.0	---	---	None	---	None
		April	1.5-2.5	2.0-5.0	---	---	None	---	None
		December	1.5-2.5	2.0-5.0	---	---	None	---	None
CkD:									
Clarksville	B	Jan-Dec			---	---	None	---	None
CIE:									
Clarksville	B	Jan-Dec			---	---	None	---	None
CIF:									
Clarksville	B	Jan-Dec			---	---	None	---	None
LoB:									
Tonti	C	January	1.5-2.5	2.0-5.0	---	---	None	---	None
		February	1.5-2.5	2.0-5.0	---	---	None	---	None
		March	1.5-2.5	2.0-5.0	---	---	None	---	None
		April	1.5-2.5	2.0-5.0	---	---	None	---	None
		December	1.5-2.5	2.0-5.0	---	---	None	---	None
SgD:									
Britwater	B	Jan-Dec			---	---	None	---	None

Water Features (K1)

Delaware County, Oklahoma

Map symbol and soil name	Hydrologic group	Month	Water table		Ponding			Flooding	
			Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
			Ft	*Ft*	*Ft*				
Sn:									
Razort	B	January	---	---	---	---	None	Brief	Occasional
		February	---	---	---	---	None	Brief	Occasional
		March	---	---	---	---	None	Brief	Occasional
		April	---	---	---	---	None	Brief	Occasional

Soil Features (K2)

Delaware County, Oklahoma

[Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Map symbol and soil name	Restrictive layer				Subsidence		Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness	Initial	Total		Uncoated steel	Concrete
		In	*In*		*In*	*In*			
BcB:									
Macedonia	---	---	---	---	0	---	Moderate	Moderate	High
BIC:									
Doniphan	---	---	---	---	0	---	Moderate	Moderate	High
Tonti	---	---	---	---	0	---	None	High	High
CkD:									
Clarksville	---	---	---	---	0	---	Moderate	Low	High
CIE:									
Clarksville	---	---	---	---	0	---	Moderate	Low	High
CIF:									
Clarksville	---	---	---	---	0	---	Moderate	Low	High
LoB:									
Tonti	---	---	---	---	0	---	None	High	High
SgD:									
Britwater	---	---	---	---	0	---	None	Moderate	Moderate
Sn:									
Razort	---	---	---	---	0	---	None	Low	Low

2006 ANNUAL LITTER PLAN

For: Da and Tia Yang

Litter from Full House Cleanout

Application Date	Litter Source	Field No.	Acres	Tons/acre	Total tons/field
November-December	Yang Hen Litter	40 North	17.4	1.71	29.8
November-December	Yang Hen Litter	South	11.6	1.71	19.8
November-December	Yang Hen Litter	Middle	10.3	1.71	17.6
November-December	Yang Hen Litter	West	12.5	0.85	10.6
November-December	Yang Hen Litter	Saline Creek	15.[illegible]	2	340

Estimated tons of litter produced	500
Tons of litter to be land applied	107.9
Estimated tons to be exported off farm	39[illegible]

Notes:

Calibrate truck prior to spreading.

An estimated 392 tons will need to be exported from the farm. Keep records.

The allowable poultry litter application rates in this plan have been determined utilizing the Eucha/Spavinaw Phosphorus Index as approved by the Federal Court Northern District of Oklahoma for implementation under the settlement Agreement in Case No. 01 CV 0900EA(C).

A&L Analytical Laboratories, Inc.

SOIL ANALYSIS

Test	Results
Buffer pH	
Phosphorus (P)	
Potassium (K)	
Calcium (Ca)	
Magnesium (Mg)	
Sulfur (S)	
Boron (B)	
Copper (Cu)	
Iron (Fe)	
Manganese (Mn)	
Zinc (Zn)	
Sodium (Na)	
Soluble Salts	
Organic Matter	
Nitrate Nitrogen	

SOIL TEST RATINGS

Very Low | Low | Medium | Optimum | Very High

11.5

meq/100g

Calculated Cation Saturation

%K	3.6
%Ca	65.7
%Mg	19.8
%H	10.9

Ca:Mg Ratio

3.32

SOIL FERTILITY GUIDELINES

Crop: Yield Goal: Rec Units:

N	P_2O_5	K_2O	Mg	S	B	Cu	Mn	Zn	Fe

Crop: Yield Goal: Rec Units:

N	P_2O_5	K_2O	Mg	S	B	Cu	Mn	Zn	Fe

BERMUDAGRASS PASTURE

RESCUE PASTURE

A&L Analytical Laboratories, Inc.

SOIL ANALYSIS

Lab Number: Field Id: Sample Id:

Test	Results
Soil pH	
Buffer pH	
Phosphorus (P)	
Potassium (K)	
Calcium (Ca)	
Magnesium (Mg)	
Sulfur (S)	
Boron (B)	
Copper (Cu)	
Iron (Fe)	
Manganese (Mn)	
Zinc (Zn)	
Sodium (Na)	
Soluble Salts	
Organic Matter	
Nitrate-Nitrogen	

SOIL TEST RATINGS

Very Low	Low	Medium	Optimum	Very High

7.0

meq/100g

Calculated Cation Saturation

%K	5.0
%Ca	65.5
%Mg	12.7
%H	16.8

Ca/Mg Ratio

5.16

SOIL FERTILITY GUIDELINES

Crop: Yield Goal: Rec Units:

lbs/A	P_2O_5	lbs/A	N	P_2O_5	K_2O	Mg	S	B	Cu	Mn	Zn	Fe
20-0				0	30	0						

Crop: Yield Goal: Rec Units: lbs/A

lbs/A

BERMUDAGRASS PASTURE

FESCUE PASTURE

A&L Analytical Laboratories, Inc.

SOIL ANALYSIS

Lab Number: Sample ID:

Test	Results	SOIL TEST RATINGS					
		Very Low	Low	Medium	Optimum	Very High	
Soil pH							13.0
Buffer pH							
Phosphorus (P)							
Potassium (K)							Calculated Cation Saturation
Calcium (Ca)							K
Magnesium (Mg)							Ca
Sulfur (S)							Mg
Boron (B)							H
Organic Matter (OM)							
Iron (Fe)							
Manganese (Mn)							
Zinc (Zn)							
Sodium (Na)							K / Mg Ratio
Soluble Salts							
Organic Matter							
Nitrate Nitrogen							

SOIL FERTILITY GUIDELINES

Crop: Yield Goal: Rec Units:

N	P_2O_5	K_2O	Mg	S	B	Cu	Mn	Zn	Fe

Crop: Yield Goal: Rec Units:

N	P_2O_5	K_2O	Mg	S	B	Cu	Mn	Zn	Fe

BERMUDAGRASS PASTURE

TEXOMA PASTURE

A&L Analytical Laboratories, Inc.

SOIL ANALYSIS

Test	Results
Soil pH	
Buffer pH	
Phosphorus (P)	
Potassium (K)	
Calcium (Ca)	
Magnesium (Mg)	
Sulfur (S)	
Boron (B)	
Copper (Cu)	
Iron (Fe)	
Manganese (Mn)	
Zinc (Zn)	
Sodium (Na)	
Soluble Salts	
Organic Matter	
Nitrate Nitrogen	

SOIL TEST RATINGS

Very Low	Low	Medium	Optimum	Very High

18.8

meq/100g

Calculated Cation Saturation

%K	2.0
%Ca	69.7
%Mg	8.4
%H	9.8

K : Mg Ratio

0.33

SOIL FERTILITY GUIDELINES

Crop: Yield Goal: Rec Units:

pH	LIME	N	P_2O_5	K_2O	Mg	S	B	Ca	Mn	Zn	Fe

Crop: Yield Goal: Rec Units:

pH	LIME	N	P_2O_5	K_2O	Mg	S	B	Ca	Mn	Zn	Fe

BERMUDAGRASS PASTURE

ESCOL PASTURE

Soil, Water & Forage Analytical Laboratory
Oklahoma State University
046 Agricultural Hall, Stillwater, OK 74078
Email: Soils_lab@mail.pss.okstate.edu

SOIL TEST REPORT

DELAWARE CTY EXT OFC	Name	Lab ID No.:
	Da Yang	Customer Code:
PO BOX 1020	Location: Farm 440	Sample No.:
JAY OK 74346	54296 CR 593	Received:
(918) 253-4332	COLCORD OK 74338	Report Date:

Routine Test		Secondary Nutrients		Micronutrients
pH	5.5	SO4 S(lbs/A):		Fe (ppm)
Buffer Index	6.8	Surface:		Zn (ppm)
NO3-N (lbs/A)		Subsoil:		B (ppm)
Surface	16	Ca (lbs/A):		
Subsoil		Mg(lbs/A):		
Soil Test P Index	35			
Soil Test K Index	208	Additional Tests		

Interpretation and Requirements for *Bermudagrass* (YIELD GOAL)

Test	Interpretation	Requirement	Recommendation and Comments
pH	Lime needed	1.2 tons ECCE/A	
Nitrogen	Deficient	244.0 lbs/acre N	
Phosphorus	91 % Sufficient	25.0 lbs/acre P_2O_5 annually	
Potassium	96 % Sufficient	26 lbs /acre K_2O annually	

Additional Comments:

DELAWARE COUNTY OSU EXTENSION OFF
PO BOX 1020 - FAIR GROUNDS
JAY, OK 74346
(918) 253-4332

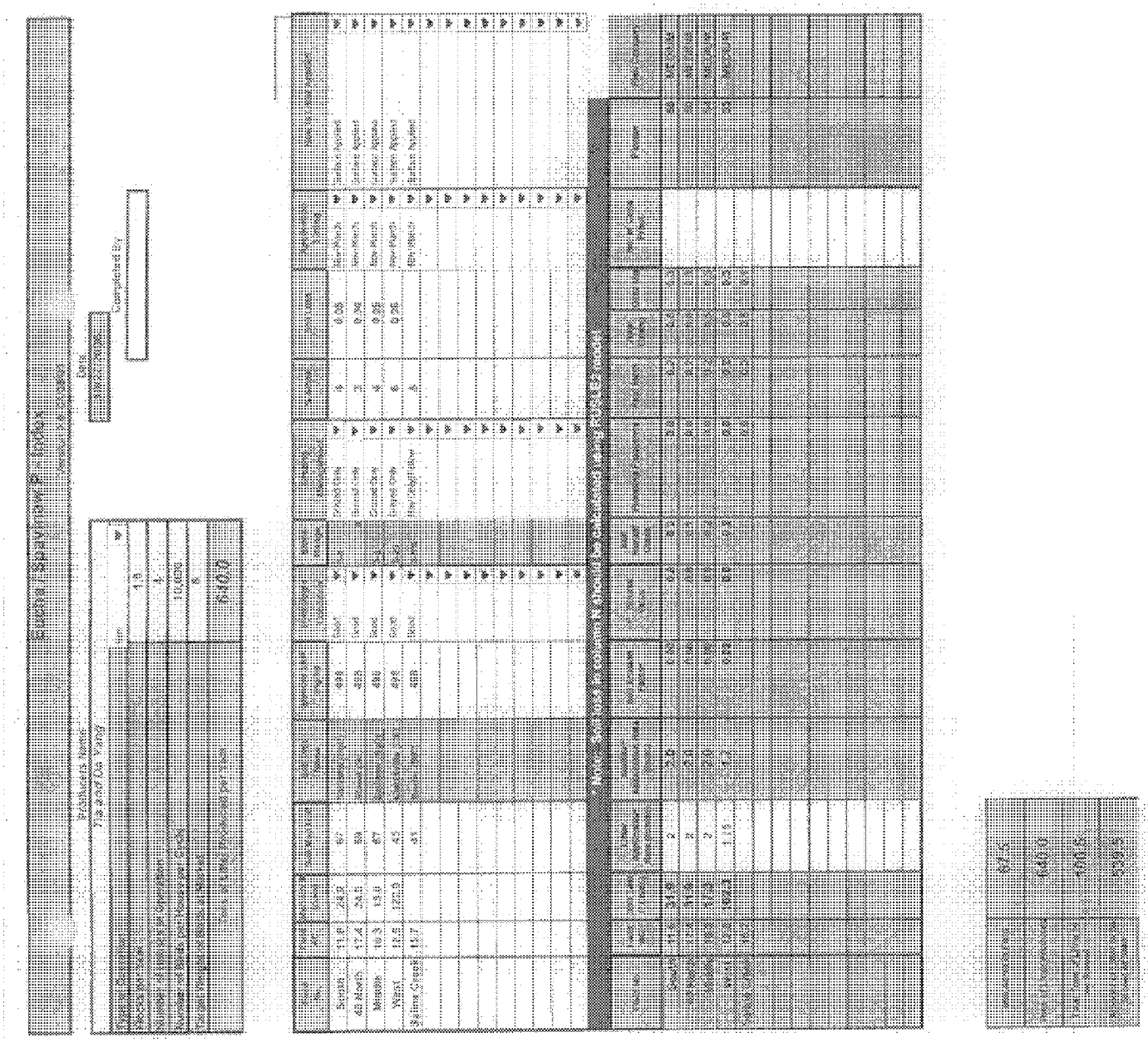
Signature

AGRICULTURAL DIAGNOSTIC LABORATORY
UNIVERSITY OF ARKANSAS - FAYETTEVILLE
***MANURE FOR FERTILIZER ANALYSIS (report for AGRI-429)

Name	JOHN EVERETT	Received:	10/16/2006
Address.	P.O. BOX 248	Mailed:	10/25/2006
City	DECATUR	State,Zip.	AR 72722
FAX.	479-752-5707	CK#.	

Lab. No.	M61338			M61338	
Sample No.	TIA & DA'S FARM			TIA & DA'S FARM	
Animal type	hens				
-age/lbs	none given				
Bedding type	none given				
Manure type	cleanout				
Sample date	10/05/2006				
Age of manure	none given				
pH	8.9				
Ec(umhos)	6750				
% H20	28.0				
	on dry basis				
Total %N	3.07				
Total %P	2.56				
Total %K	3.15		Total Dissolved P, mg/kg	692	
Total %Ca	10.98				
Total %Carbon	29.73				
NO3-N, mg/kg	31				
NH4-N, mg/kg	2290				
	on "as-is" basis				
Total %N	2.21				
Total %P	1.84				
Total %K	2.27		Total Dissolved P, mg/kg	498	
Total %Ca	7.90				
Total %Carbon	21.40				
NO3-N, mg/kg	22				
NH4-N, mg/kg	1648				
	lbs/ton on "as-is" basis				
N	44.2				
P2O5	84.3				
K2O	54.9				
Ca	158.0				
Total Carbon	428.0				
NO3-N	0.04		Total Dissolved P	1.0	
NH4-N	3.3				

***all analyses performed on "as-is" basis/ "dry" basis is calculated from moisture content
Total Dissolved P: 1:10 sample:water ratio, 0.45um filter, acidified, ICP
*lbs/ton P2O5 = %Total P on "as-is" basis multiplied by 20*2.29
*lbs/ton K2O - %Total K on "as-is" basis multiplied by 20*1.2



Yang-Da.pdf

ESWM 009120

Yang-Da.pdf

ESWM 009121

Producers Name
Tia and Da Yang

Field No.	STP 4 inch (ppm)	OK NRCS 590 (Table 9) P2O5 lb/acre	Total P (ppm) in litter	Total P per acre allowable	OK NRCS 590 Ton/acre	ESPI allowed Ton/acre	Rate that is allowed
South	24	200	25600	87.34	1.71	2	1.71
40 North	24	200	25600	87.34	1.71	2	1.71
Middle	13	200	25600	87.34	1.71	2	1.71
West	122	100	25600	43.67	0.85	1.75	0.85
Saline Creek							

40 north 2006.txt

Created 11/21/2006 5:12:38 PM by PPM Calculator Version 2.0

Field Owner: Da Yang
Plan Developer: l
Field Description: 40 North
Plan Date: 11-21-06
Field Area (acres): 17.4
Field Slope (%): 3
Soil Type: Sn RAZORT Hydrologic Group B
Curve Number: 56
Forage Type: Mixed
Soil Test P (ppm): 24
Minimum Standing Forage (lb/acre): 1200
Forage Yield Goal (ton/acre): 3
UTM Coordinates: 336621E 4012004N UTM 83
Allowed P Allocation (lb/acre/year): 0.00
Hay Harvested (ton/acre/year): 0.0

Month	Hay Stocking Rate (AU/acre)	Litter N (Lb/acre)	Litter P2O5 (Lb/acre)	Commercial N (Lb/acre)	Commercial P2O5 (Lb/acre)	Precip (in)	Runoff (in)	Sediment (t/acre)	Total Phosphorus (lb/acre)	Available Forage (Dry ton/acre)
Jan	0.2	0	0	0	0	1.56	0.12	0.000	0.03	0.15
Feb	0.2	0	0	0	0	2.19	0.31	0.000	0.08	0.17
Mar	0.2	0	0	0	0	3.88	0.23	0.000	0.05	0.31
Apr	0.2	0	0	0	0	3.87	0.28	0.000	0.07	0.46
May	0.2	0	0	0	0	4.65	0.11	0.000	0.02	0.79
Jun	0.2	0	0	0	0	4.37	0.23	0.001	0.05	1.86
Jly	0.2	0	0	0	0	2.64	0.00	0.000	0.00	2.79
Aug	0.2	0	0	0	0	3.77	0.01	0.000	0.00	3.15
Sep	0.2	0	0	0	0	3.34	0.10	0.000	0.02	3.09
Oct	0.2	0	0	0	0	3.67	0.13	0.000	0.03	3.02
Nov	0.2	76	144	0	0	3.87	0.14	0.000	0.04	0.15
Dec	0.2	0	0	0	0	2.45	0.13	0.000	0.04	0.15
Annual Totals		76	144	0	0	40.26	1.79	0.003	0.43	

WARNING: PPM Calculator predicts this management scenario will exceed the allowable phosphorus load by 433947.1%

south 2006.txt

Created 11/21/2006 5:11:11 PM by PPM Calculator Version 2.0

Field Owner: Da Yang
Plan Developer: J
Field Description: south
Plan Date: 11-21-06
Field Area (acres): 11.6
Field Slope (%): 4
Soil Type: SgD BRITWATER Hydrologic Group B
Curve Number: 56
Forage Type: Mixed
Soil Test P (ppm): 24
Minimum Standing Forage (lb/acre): 1200
Forage Yield Goal (ton/acre): 3
UTM Coordinates: 336587E 4011820N UTM 83
Allowed P Allocation (lb/acre/year): 0.00
Hay Harvested (ton/acre/year): 0.0

Month	Hay Stocking Rate (AU/acre)	Litter N (Lb/acre)	Litter P2O5 (Lb/acre)	Commercial N (Lb/acre)	Commercial P2O5 (Lb/acre)	Precip (in)	Runoff (in)	Sediment (t/acre)	Total Phosphorus (lb/acre)	Available Forage (Dry ton/acre)
Jan	0.2	0	0	0	0	1.56	0.28	0.001	0.07	0.14
Feb	0.2	0	0	0	0	2.19	0.54	0.003	0.15	0.19
Mar	0.2	0	0	0	0	3.88	0.61	0.004	0.17	0.33
Apr	0.2	0	0	0	0	3.87	0.67	0.004	0.18	0.46
May	0.2	0	0	0	0	4.65	0.36	0.002	0.09	0.75
Jun	0.2	0	0	0	0	4.37	0.45	0.004	0.13	1.74
Jly	0.2	0	0	0	0	2.64	0.02	0.000	0.00	2.61
Aug	0.2	0	0	0	0	3.77	0.02	0.000	0.00	2.96
Sep	0.2	0	0	0	0	3.34	0.17	0.001	0.04	2.89
Oct	0.2	0	0	0	0	3.67	0.24	0.002	0.06	2.82
Nov	0.2	76	144	0	0	3.87	0.31	0.001	0.10	0.14
Dec	0.2	0	0	0	0	2.45	0.39	0.002	0.14	0.14
Annual Totals		76	144	0	0	40.26	4.05	0.023	1.14	

WARNING: PPM Calculator predicts this management scenario will exceed the allowable phosphorus load by 1141124.9%

Middle 2006.txt

Created 11/21/2006 5:14:35 PM by PPM Calculator version 2.0

Field Owner: Da Yang
Plan Developer: l
Field Description: Middle
Plan Date: 11-21-06
Field Area (acres): 10.3
Field Slope (%): 4
Soil Type: SgD BRITWATER Hydrologic Group B
Curve Number: 56
Forage Type: Mixed
Soil Test P (ppm): 13
Minimum Standing Forage (lb/acre): 1200
Forage Yield Goal (ton/acre): 3
UTM Coordinates: 336369E 4011939N UTM 83
Allowed P Allocation (lb/acre/year): 0.00
Hay Harvested (ton/acre/year): 0.0

Month	Hay Stocking Rate (AU/acre)	Litter N (Lb/acre)	Litter P2O5 (Lb/acre)	Commercial N (Lb/acre)	Commercial P2O5 (Lb/acre)	Precip (in)	Runoff (in)	Sediment (t/acre)	Total Phosphorus (lb/acre)	Available Forage (Dry ton/acre)
Jan	0.2	0	0	0	0	1.56	0.28	0.001	0.07	0.14
Feb	0.2	0	0	0	0	2.19	0.54	0.003	0.15	0.19
Mar	0.2	0	0	0	0	3.88	0.61	0.004	0.16	0.33
Apr	0.2	0	0	0	0	3.87	0.67	0.004	0.18	0.46
May	0.2	0	0	0	0	4.65	0.36	0.002	0.09	0.75
Jun	0.2	0	0	0	0	4.37	0.45	0.004	0.12	1.74
Jly	0.2	0	0	0	0	2.64	0.02	0.000	0.00	2.61
Aug	0.2	0	0	0	0	3.77	0.02	0.000	0.00	2.96
Sep	0.2	0	0	0	0	3.34	0.17	0.001	0.04	2.89
Oct	0.2	0	0	0	0	3.67	0.24	0.002	0.06	2.82
Nov	0.2	76	144	0	0	3.87	0.31	0.001	0.10	0.14
Dec	0.2	0	0	0	0	2.45	0.39	0.002	0.14	0.14
Annual Totals		76	144	0	0	40.26	4.05	0.023	1.12	

WARNING: PPM Calculator predicts this management scenario will exceed the allowable phosphorus load by 1119776.4%

West 2006.txt

Created 11/21/2006 5:18:13 PM by PPM Calculator Version 2.0

Field Owner: Da Yang
Plan Developer: 1
Field Description: West
Plan Date: 11-21-06
Field Area (acres): 12.5
Field Slope (%): 6
Soil Type: ClE CLARKSVILLE Hydrologic Group B
Curve Number: 56
Forage Type: Mixed
Soil Test P (ppm): 122
Minimum Standing Forage (lb/acre): 1200
Forage Yield Goal (ton/acre): 3
UTM Coordinates: 336132E 4011701N UTM 83
Allowed P Allocation (lb/acre/year): 0.00
Hay Harvested (ton/acre/year): 0.0

Month	Hay Stocking Rate (AU/acre)	Litter N (Lb/acre)	Litter P2O5 (Lb/acre)	Commercial N (Lb/acre)	Commercial P2O5 (Lb/acre)	Precip (in)	Runoff (in)	Sediment (t/acre)	Total Phosphorus (lb/acre)	Available Forage (Dry ton/acre)
Jan	0.2	0	0	0	0	1.56	0.21	0.000	0.04	0.09
Feb	0.2	0	0	0	0	2.19	0.42	0.001	0.08	0.12
Mar	0.2	0	0	0	0	3.88	0.55	0.002	0.11	0.21
Apr	0.2	0	0	0	0	3.87	0.63	0.002	0.12	0.33
May	0.2	0	0	0	0	4.65	0.33	0.001	0.06	0.62
Jun	0.2	0	0	0	0	4.37	0.45	0.002	0.08	1.32
Jly	0.2	0	0	0	0	2.64	0.02	0.000	0.00	1.77
Aug	0.2	0	0	0	0	3.77	0.04	0.000	0.01	1.94
Sep	0.2	0	0	0	0	3.34	0.23	0.001	0.04	1.87
Oct	0.2	0	0	0	0	3.67	0.29	0.001	0.05	1.80
Nov	0.2	38	72	0	0	3.87	0.44	0.001	0.09	0.09
Dec	0.2	0	0	0	0	2.45	0.41	0.001	0.09	0.09
Annual Totals		38	72	0	0	40.26	4.03	0.011	0.77	

WARNING: PPM Calculator predicts this management scenario will exceed the allowable phosphorus load by 774810.3%

Record Keeping Documents

The settlement agreement requires that records be kept of the quantity of poultry litter, manure, or other nutrients that are land applied or transferred. Forms are provided within this section to maintain this information. Below is a brief description of the record keeping documents and the information that should be provided.

LITTER APPLICATION FIELD RECORD

This form is to be used to record all land applications of poultry waste on lands that you own or manage. This form is in triplicate to allow copies to be given to spreaders/haulers if needed. One copy will be given to the watershed management team for their records.

POULTRY LITTER EXPORT RECORD

This form is to be used to record the amount and destination of any litter that leaves the farm. If litter is being shipped out of the Spavinaw watershed, indicate which watershed it is being shipped to. If litter is shipped to another farm within the Spavinaw watershed, be sure that the landowner has a valid nutrient management plan issued by the Eucha Spavinaw watershed management team.

COMMERCIAL FERTILIZER APPLIED

This form is to be used to record the amount of commercial fertilizer and date of application to each field. Commercial nitrogen or potassium (potash) can be applied to lands within the watershed without a spreading plan. Commercial phosphorus should not be applied in the watershed.

LITTER APPLICATION FIELD RECORD

THIS FORM MUST BE COMPLETED, SIGNED AND PROVIDED TO THE WATERSHED MANAGEMENT TEAM FOR ANY POULTRY LITTER APPLIED IN THE EUCHA/SPAVINAW WATERSHED. IF LITTER WAS EXPORTED FROM THE WATERSHED, THE EXPORT RECORD MUST BE COMPLETED.

Farm Owner (where spread) _____

Farmer Owner Address _____

_____

Spreader Operator Name _____

Spreader Operator Address _____

Grower: _____

Farm Name _____

Address _____

Decake or Full House Clean out	Field Name/#	Date Applied (Mo/day/yr)	Litter Applied Tons/Acre	Total Applied Tons/Field

CERTIFICATION

By signing below, I certify that I have read the Nutrient Management Plan (NMP) of the above named grower and litter source and the NMP for the Farm Owner where the litter is being spread *(if different)*; that all handling and land application of the litter listed on this form was performed in accordance with the NMP; that no litter was removed that is not listed on this form; and that the information provided on this form is complete, true, and accurate to the best of my information and belief.

Poultry Grower: _____ Date: _____

Hauler/Spreader: _____ Date: _____

Record Received by E/S WMT

Name: _____ Signature: _____ Date: _____

WTRSHD002 • 8/0

Yang-Da.pdf

ESWM 009128

PI-Fisher0024671

POULTRY LITTER EXPORT RECORD

THIS FORM MUST BE COMPLETED, SIGNED AND PROVIDED TO THE WATERSHED MANAGEMENT TEAM FOR ANY LITTER THAT HAS BEEN EXPORTED FROM A POULTRY FARM IN THE EUCHA/SPAVINAW WATERSHED. IF LITTER WAS LAND APPLIED ON THE GROWER'S FARM OR ANOTHER FARM IN THE EUCHA/SPAVINAW WATERSHED, THE LITTER APPLICATION FIELD RECORD MUST BE COMPLETED.

Grower _____
Farm Name _____
Address _____
_____
Phone _____

Hauler's Name _____
Business Name _____
Hauler's Address _____
_____
Hauler's Phone _____

Date Hauled	Recipient's Name	Recipient's Street Address	City/State	Watershed Where Litter was Applied	Tons of Litter Hauled

CERTIFICATION
I certify that I have read the Nutrient Management Plan (NMP) of the above named grower and litter source; that all handling and transport of the litter listed on this form was performed in accordance with the NMP; that no litter was removed that is not listed on this form; and that the information provided on this form is complete, true, and accurate to the best of my information and belief.

Poultry Grower: _____ Date: _____

Hauler: _____ Date: _____

Record Received by E/S WMT

Name: _____ Signature _____ Date: _____

WTRSHD001 • 3/06

Yang-Da.pdf

ESWM 009129

PI-Fisher0024672

Commercial Fertilizer Applications

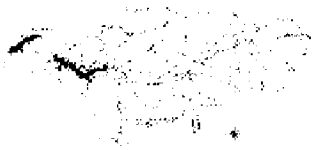
Field	Date Applied	Amount Applied				
		Ammonia Nitrate	Urea	Potash	Other	

Appendix A

Litter Spreader Calibration Calculations

Loads Per Field Method

Tarp Method Using Equipment Settings



Case No. CV 0090E-JHC-U.S. District Court, Northern District of Oklahoma

Eucha/Spavinaw Watershed Management Team

P.O. Box 248
Decatur, AR 72722

John Everett, J.D., P.E., Special Master
johneverett@cox-internet.com
Tel: 479-752-5701
Fax: 479-752-5707 Cell: 479-752-5819

LAND APPLICATION RECORD OF POULTRY LITTER BY LOADS PER FIELD METHOD

Calculation of allowable rates of land application of poultry litter according to the Phosphorous Index (PI) approved by the Court for the watershed has generally resulted in allowable rates less than 1.5 tons/acre and frequently less than 1.0 ton per acre. Initially the E/S WMT was informed by the University of Arkansas developers of the PI that, since calibration of application at such low application rates is not accurate and rarely obtainable, no litter application is recommended when the calculated allowable rate is less than 1.0 tons/acre. This limitation was written into the PI itself as *a recommendation*. This limitation also corresponded well with a majority of comments provided to the Special Master by commercial spreaders that spreading at rates of less than 1.5 tons/acre was not industry practice and was not feasible. Subsequently, however, numerous landowners have indicated that they continue to desire to spread litter as fertilizer at even such lower rates and a number of spreaders have indicated their willingness and ability to do so. Therefore the following alternative method has been developed for strictly controlling the amount of litter to be applied to a field in accordance with the calculated allowable amount when the allowable amount is less than 1.5 tons/acre. This method requires the spreader to calculate the actual number of loads of litter that *may* be applied to a particular field based on the volume of the spreader equipment, the density of the litter, and the calculated allowable tons of litter/acre from the nutrient management plan for the field. **UNLESS THIS METHOD IS FOLLOWED AND THE INCLUDED RECORDS COMPLETED AND MAINTAINED, THEN NO POULTRY LITTER APPLICATION TO LAND WILL BE ALLOWED UNDER THE SETTLEMENT AGREEMENT FOR THE EUCHA/SPAVINAW WATERSHED WHEN THE CALCULATED ALLOWABLE APPLICATION RATE IS LESS THAN 1.0 TONS/ACRE.** NOTE THAT NOT ALL SPREADERS WILL BE WILLING OR ABLE TO UTILIZE THIS METHOD DUE TO PRACTICE PREFERENCES OR EQUIPMENT LIMITATIONS. This method may also optionally be utilized for control of rates greater than or equal to 1.0 tons/acre as some spreaders are beginning to prefer this method as more convenient and reliable than conventional tarp spreading and weighing methods in the field. John Everett, J.D., P.E., Special Master, March 31, 2004.

POULTRY LITTER LAND APPLICATION RECORD: **I certify that the following information and calculations are true and complete to the best of my information and belief:**

Field No. _____: _____**Acres x** _____ **Tons/Acre ÷** _____**Tons/Load =** _____ **Loads/Field**

Field No. _____: _____**Acres x** _____ **Tons/Acre ÷** _____**Tons/Load =** _____ **Loads/Field**

Field No. _____: _____**Acres x** _____ **Tons/Acre ÷** _____**Tons/Load =** _____ **Loads/Field**

Field No. _____: _____**Acres x** _____ **Tons/Acre ÷** _____**Tons/Load =** _____ **Loads/Field**

Field No. _____: _____**Acres x** _____ **Tons/Acre ÷** _____**Tons/Load =** _____ **Loads/Field**

Field No. _____: _____**Acres x** _____ **Tons/Acre ÷** _____**Tons/Load =** _____ **Loads/Field**

Field No. _____: _____**Acres x** _____ **Tons/Acre ÷** _____**Tons/Load =** _____ **Loads/Field**

Field No. _____: _____**Acres x** _____ **Tons/Acre ÷** _____**Tons/Load =** _____ **Loads/Field**

Source of Litter: _____

Spreader Name _____ **Signature** _____ **Date** _____

Spreader Address _____ **Phone** _____

Landowner Name _____ **Signature** _____ **Date** _____

Landowner Address _____ **Phone** _____

CALCULATIONS:

VOLUME OF TRUCK/SPREADER in Cubic Yards = _____ **C.Y./Load**
(Obtain information from Manufacturer or measure and calculate the bed volume; be sure the volume is for the fill level you intend to utilize.)

DENSITY OF LITTER = _____ **Pounds Per Cubic Foot (lbs/ft^3)**
Method: Fill a 5 gallon bucket with representative sample of litter to be spread.
Weigh the 5 gallon bucket of litter in pounds = _____ Pounds/5 gal. Subtract the weight of the bucket itself
Multiply the weight of the 5 gallon bucket of litter by 1.5 to get Pounds Per Cubic Foot

DENSITY OF LITTER = _____ **Tons Per Cubic Yard (Ton/C.Y.)**
Multiply Pounds per cubic foot by 0.0135 to get Tons Per Cubic Yard

CALCULATE TONS PER LOAD = Volume of Truck/Spreader ÷ Density of Litter

_____**C.Y./Load x** _____**Ton/C.Y. =** _____**Tons/Load** (Alternatively, determine directly at commercial scale.)

NUMBER OF LOADS ALLOWED PER FIELD = Acres x Allowable Tons/Acre ÷ Calculated Tons/Load = Loads/Field.
(Complete for each field in table above.)

UofA UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE
Cooperative Extension Service

Agriculture and Natural Resources

Calibrating Poultry Litter Spreader Trucks

Karl VanDevender, Ph.D., P.E.
Extension Engineer

Gary Huitink, P.E.
Extension Engineer

Traditionally, poultry litter application rates based on truckloads per field have been considered acceptable. Today, there are increasing environmental concerns regarding soil test phosphorus levels and the potential impact on water quality. As a result of these concerns, it is generally recommended, and in some cases a permit requirement, that each poultry farm develop a comprehensive nutrient management plan. These plans document the volume of litter produced and managed on each farm. The documentation includes estimates of the nitrogen, phosphorus and potassium content of the litter, and calculations of the appropriate application rates to meet the farm's pasture and hay fertility needs while at the same time, protecting water quality. In these nutrient management plans, the application rates are expressed as tons of litter per acre. For more information on soil test phosphorus concerns and comprehensive nutrient management plans, contact your local county Extension office.

To identify how many tons of litter are being applied, litter application equipment should be calibrated for specific equipment settings and operating conditions. With proper calibration, controlled applications can be made to meet crop needs, protect the environment, reduce litter wastage and possibly provide cash revenue from the sale of unused litter.

Several factors need to be considered when applying litter. The primary factors are the average application rate and the application uniformity. If the application rate is too low, the crop's nutrient needs are not met. If they are too high, not only are nutrients wasted that may have been marketed, there also is an increased risk for the excess nutrients to enter streams with rainfall runoff. If the application is not uniform, some areas are over-fertilized and other areas under-fertilized, resulting in streaking and a reduction in forage production. Spreader swath width is a key factor in controlling application uniformity.

The spreader swath width, litter application rate and distribution uniformity can be evaluated fairly quickly. Methods explained in the following sections emphasize simple approaches that can be used to modify spreading techniques to remedy any weaknesses. A typical analysis first samples the distribution of poultry litter. If this distribution is uniform, a good estimate (±20 percent) of the tonnage applied per acre can be determined. Obtaining this litter application rate, in tons per acre, is the best way to estimate the nutrients applied.

The University of Arkansas Agricultural Diagnostic Laboratory will analyze litter for nutrients. Well-blended samples of litter from several loads or from multiple sites in the poultry house should be combined to obtain realistic average values. Interested persons should contact their county Extension agent for details on how to benefit from a laboratory litter analysis and how to obtain a representative sample.

To maximize the value of a litter calibration procedure, choose a level area in the field and sample when the wind is not gusty. Samples

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http://www.uaex.edu

obtained when the wind velocity is below 10 miles per hour display the characteristics of the litter and the spreader. A smooth wheel track reduces spreader bouncing and tilting. Any distortions of the spread pattern caused by wind or spreader bounce will only confuse the analysis rather than simulating typical pasture operating conditions. The discharge rate, gear settings and PTO speed should all be at the settings normally used. The spreader should be engaged and distributing litter at a uniform rate well before it crosses the sampling surface.

Determining Swath Width

STEP 1. Obtain a roll of paper 24 to 36 inches wide that contrasts with the general color of the poultry litter to be spread. (Grocers, butchers and office supply stores may carry large rolls of white paper.) Locate a smooth area where poultry litter is to be spread. Unroll 50 to 75 feet of paper perpendicular to the intended path of the litter spreader. Place weights (rocks, sticks, bricks, etc.) along the length of the paper as you unroll it. This will prevent the wind from lifting it or causing portions of it to flutter. A litter sample typical of the spreader is needed from the entire width where litter is thrown.

STEP 2. Locate the center of the unrolled paper and position two or three small flags in a line perpendicular to the paper at the center. Flags should be chosen that can be straddled with equipment without concern for damage. Figure 1 shows the flags located about 100 yards apart to guide the operator.

STEP 3. With spreader settings and speed typical of normal operation, make one pass directly across the center of the paper using the flags for guidance. If another person is available to operate the spreader, it is helpful to observe the paper while sampling is underway. One possible cause of sampling error is the wind turning the paper over, etc., while the spreader passes. The observer can position himself behind and off to the side of the spreader to monitor the discharge as the vehicle crosses the sample paper to assure a normal feed rate. Since rocks and chunks of litter can be thrown from the spreader, observers need to be alert and far enough away for personal safety.

STEP 4. Evaluate the litter deposition along the entire length of the sample paper. The maximum deposition should be at the center, and the rate gradually decreases to the limits of the spreader "throw." The "throw" distance and amount of litter spread on both sides of the spreader should also be about the same. If these conditions are met, good litter uniformity is possible. If the "throw" and litter distribution are significantly different from one side to the other, then the cause should be determined. If necessary, faulty equipment should be repaired before proceeding. Examples of mechanical items to look for are damaged vanes, and rotors that spin at different speeds.

Non-mechanical factors that can result in a poor application pattern are wind, ground slope and overloading the rotors. Wind and excessive ground slope can skew the pattern to one side. Overloading the rotors occurs when more litter is discharged onto the rotors than they can "throw" to the side of the spreader, resulting in large amounts of the litter falling off of the back edge of the rotors and directly to the ground. When this occurs, there is a heavy application directly behind the spreader and possibly a significant reduction in swath width. This is corrected by slowing the litter delivery rate (truck bed drive) to the rotors.

STEP 5. By examining litter deposition on the paper, select the distance on each side of the spreader where litter deposition appears to be half the maximum. The distance between these points is an estimate of the ideal swath width. The best distribution uniformity is possible if the distance from the spreader to the "half-maximum-deposition" point is equal on both sides. An average of three estimates is a reliable way to estimate the swath width for the combination of equipment settings and litter characteristics in the current calibration trial.

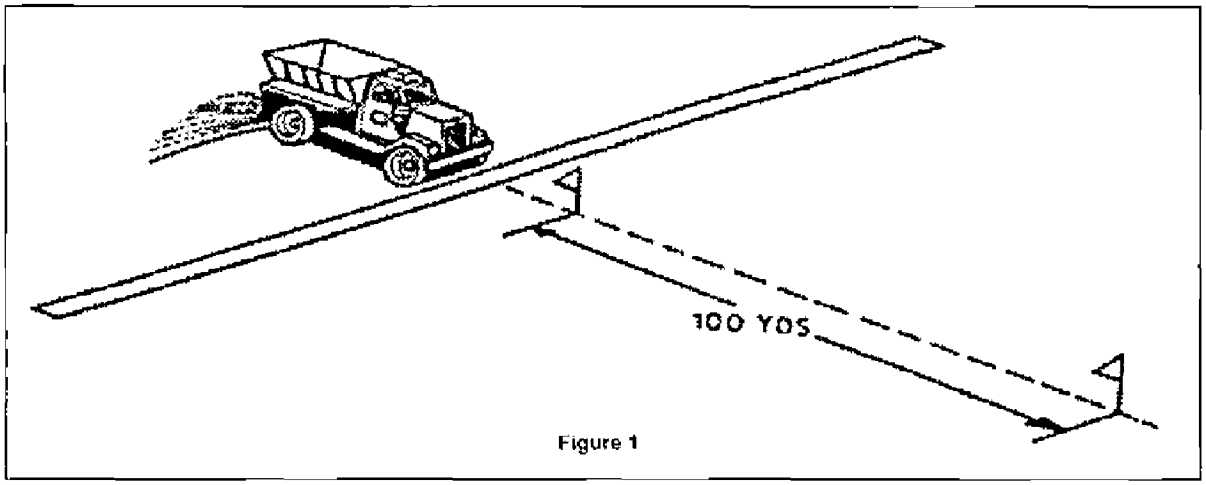

Figure 1

Evaluating Distribution Uniformity

After determining the swath width, the distribution uniformity is easily confirmed using a similar approach.

STEP 1. Unroll a length of paper equal to two swath widths perpendicular to the intended path of the litter spreader. Place weights (rocks, sticks, bricks, etc.) along the length of the paper as you unroll it. This will prevent the wind from lifting it or causing portions of it to flutter. A litter distribution sample typical of the field can be obtained across portions of three passes.

STEP 2. The ends of the paper should be unrolled to the center of alternate passes. Again, small flags can be used to guide the spreader operator to approach perpendicular to the paper for all three passes. Locate flags at both ends of the paper and in the center to guide the operator on a serpentine path shown in Figure 2. Flags should be chosen that can be straddled with equipment without concern for damage. These flags can be spaced along the serpentine path about 100 yards apart to maintain the swath width determined by the procedure in the previous section.

STEP 3. With spreader settings and speed typical of normal operation, distribute litter on the paper following the serpentine pattern. If another person is available to operate the spreader, it is helpful to observe the paper while sampling is underway. One possible cause of sampling error is the wind turning the paper over, etc., while the spreader passes. The observer can position himself off to the side of the spreader to observe the discharge when the vehicle crosses the sample tarp to assure a normal feed rate. Since rocks and chunks of litter can be thrown from the spreader, observers need to be alert and far enough away for personal safety.

STEP 4. Evaluate the litter deposition along the entire length of the sample paper. The litter should be uniformly distributed throughout the length of the sample paper. If this is not the case, the swath width can be adjusted and a second test performed. If the litter applied in the center point between adjacent passes is too light, then decrease the swath width. If it is too heavy in the center, try increasing the swath width.

Determining Application Rate

Using these techniques to obtain swath width and application uniformity increases confidence in the distribution uniformity of the litter and prepares you for an application rate measurement. The two basic approaches to determining application rate are the *loads per field* and *weight per area* methods.

Loads Per Field Method

With the *loads per field* method, an estimate of the litter weight per load times the number of loads per field divided by the number of acres in the field determines the rate at which the litter was applied. This approach is primarily a method of keeping records, not a planning tool, because the application is completed before the rate is determined. Reducing the rate is not possible after the litter has been applied to the entire field.

To use the *loads per field* method, an estimate of the litter density is required. One method of obtaining an estimate is to weigh a truck load of litter. The litter weight per load is calculated as the full weight minus the empty truck weight. Another approach is to calculate the volume of the litter in a load and multiply that times the density of the litter. Both of these approaches assume that all the loads applied to a given field are the same weight. The litter volume and density worksheets at the end of

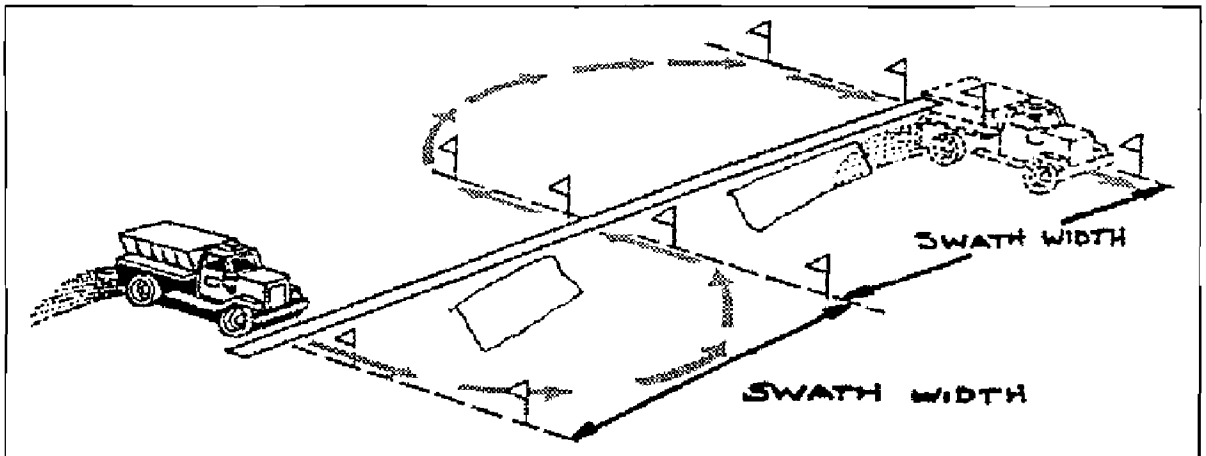

Figure 2

this publication provide formulas to help estimate the litter densities and truck volumes. Table 1 summarizes the typical range of weight, volume and density of loads of broiler litter measured in calibration workshops in Arkansas.

Table 1. Findings From Poultry Litter Spreader Truck Calibration Workshops In Arkansas*

	Weight	Volume	Density**
Minimum	2.9 tons	150.1 ft^3	27.9 lb/ft^3
Average	5.1 tons	317.2 ft^3	32.7 lb/ft^3
Maximum	6.1 tons	356.7 ft^3	38.2 lb/ft^3

* Information is from the calibration of 10 trucks.
** Minimum, Average, Maximum values of the broiler litter densities calculated for the individual truck loads.

Weight Per Area Method

With the *weight per area* method, tarps are used to catch litter applied under normal application conditions. The application rate is then calculated by dividing the weight of the litter caught on the surface of the tarp and converting the results to tons/acre. This estimated application rate is much more reliable after the correct swath width is chosen, and the litter distribution is uniform.

The *weight per area* method has the advantage of determining the application rate for a given set of equipment settings prior to completing the application of the litter. This allows the equipment settings to be adjusted to increase or decrease the rate for the field as needed.

It is often convenient to combine the application uniformity test described above with the application rate procedures described below. If this approach is taken, two tarps should be placed so that each receives litter from two passes as shown in Figure 2. Sampling this way provides two measured application rates, while the visual inspection verifies uniformity.

Normal spreader operational settings should be used during calibration. Ideally, to increase the reliability of the results, the application rate should be determined as the average of three calibration repetitions. The recommended procedures are given below. An example data sheet with formulas is included at the end of this publication.

STEP 1. Select a 6 mil polyethylene sheet or plastic tarp and a scale that will accurately read 1/2 pound increments or less. Locate an area where poultry litter is to be spread that is reasonably smooth, allowing the tarp to lay reasonably flat on the test area surface. Weigh the tarp before sampling to obtain a tare value. It is important to take this tare weight each time a sample is taken if the tarp is reused and wet litter remains on the surface. Turning the tarp over and shaking it will minimize material clinging to it from previous samples.

STEP 2. Locate the tarp securely in the path of the spreader. Two tarps used simultaneously on both sides of the spreader path provide helpful data. Place weights (rocks, sticks, bricks, etc.) to keep the tarps down and somewhat flat over the area. Locate an area that minimizes any driving obstacles and obstructions in the path of the litter to obtain a representative sample from the spreader. Avoid situations that increase the probability of litter rebounding off the "catch" surface.

STEP 3. With spreader settings and speed typical of normal operation, make the required number of passes past the tarps. Each tarp should catch litter from two adjacent passes of the spreader truck. If another person is available to operate the spreader, it is helpful to observe the tarp while sampling is underway. One should be alert for gusts turning the sample tarp over while the spreader passes, etc., causing sample error. The observer can position himself behind and off to the side of the spreader to observe the discharge as the vehicle passes the tarps to assure a normal feed rate. As soon as the litter has been spread, immediately weigh the tarp to minimize the opportunity for the wind or evaporation to reduce the sample weight, thus reducing its accuracy.

STEP 4. Calculate the litter weight for each tarp. To find the weight of the litter:

$$\text{Litter Weight (lb)} = \text{Combined Tarp \& Litter Weight (lb)} - \text{Tarp Weight (lb)}$$

STEP 5. Compute the application rate for each tarp. To find the weight of litter spread in tons per acre:

$$\text{Rate (tons/A)} = \frac{\text{Litter (lb)} \times 43{,}560\ (ft^2/A)}{\text{Tarp Area } (ft^2) \times 2{,}000\ (lb/ton)} = \frac{\text{Litter (lb)} \times 21.78}{\text{Tarp Area } (ft^2)}$$

STEP 6. Adjust the spreader gate opening height, swath width or bed chain speed to modify the application rate as needed to match the desired application rate. Any one of these adjustments directly affects the number of tons per acre applied. You need to repeat these six steps to determine the application rate for each set of equipment settings. Do not attempt swath widths that are too wide because this introduces considerable non-uniformity in the distribution. Segments of the swath behind the spreader will be high; and halfway to the next pass (wheel tracks), the application rate will be low.

These techniques can be hampered by wind, especially with dry litter. The amount retained on the tarp may not represent the actual application rate if dusty litter moves with the wind.

Summary

Producers desiring to better utilize their poultry litter can benefit from the proper calibration of litter spreading equipment. Modifying spreading procedures will improve soil fertility and reduce potential water pollution from litter.

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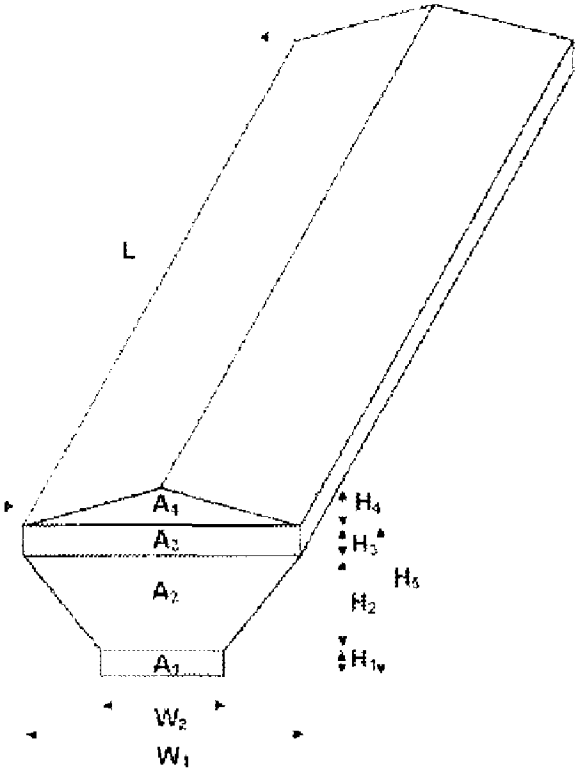
Calculating Litter Volume and Density for Spreader Trucks



VOLUME MEASUREMENTS

L = _____ in

W_1 = in

W_2 = _____ in

H_1 = _ _ in

H_2 = _____ in

H_3 = _____ in

H_4 = in

H_5 = H_1 – H_2 – H_3

H_5 = – _____ – _____

H_5 = _____ in

Truck: _____ _____ _ _

Date: _____ _____

VOLUME CALCULATIONS

$A_1 = W_2 \times H_1$

= _____ x _____ = _____ in^2

$A_2 = 0.5 \times (W_1 + W_2) \times H_2$

= 0.5 x (_____ + _____) x _____ = _____ in^2

$A_3 = W_1 \times H_3$

= _____ x _____ = _____ in^2

$A_4 = 0.5 \times W_1 \times H_4$

= 0.5 x _____ x _____ = _____ in^2

$A_T = A_1 + A_2 + A_3 + A_4$ = _____ in^2

$V = A_T \times L \div 1728\ (in^3/ft^3)$

= _____ x _____ ÷ 1728 (in^3/ft^3) = _____ ft^3

TRUCK WEIGHT MEASUREMENTS

Tire		Full	Empty	
RF	=	_____	_____	lb
LF	=	_____	_____	lb
RR	=	_____	_____	lb
LR	=	_____	_____	lb
Total	=	_____	_____	

LITTER WEIGHT CALCULATIONS

Litter = Full Truck Wt – Empty Truck Wt

= _____ – _____ = _____ lb

= _____ lb ÷ 2000 lb/ton = _____ ton

LITTER DENSITY CALCULATIONS

Density = Litter Wt ÷ Litter Volume

= _____ lb ÷ _____ ft^3 = _____ lb/ft^3

Karl VanDevender, Ph.D., P.E., Extension Engineer, 12/2002

University of Arkansas, U.S. Department of Agriculture, and County Governments Cooperating

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Calculating Litter Density With Five Gallon Buckets

FORMULA

$$\text{Litter Density (lb/ft}^3\text{)} = \text{Litter Weight (lb/bucket)} \times \frac{7.5\ (\text{gal/ft}^3)}{5\ (\text{gal/bucket})} = 1.5 \times \text{Litter Weight}$$

CALCULATIONS

Test	Full Bucket Weight (lb)		Empty Bucket Weight (lb)		Litter Weight (lb)		Litter Density (lb/ft^3)
1	_____	-	_____	=	_____	x 1.5 =	_____
2	_____	-	_____	=	_____	x 1.5 =	_____
3	_____	-	_____	=	_____	x 1.5 =	_____
						Average =	_____

PROCEDURES

1. **Fill a five-gallon bucket level full** with the litter to be spread. Since you are trying to approximate the litter density in the spreader truck, avoid big chunks. You should also drop the bucket from a few inches a few times to simulate the settling that takes place while loading the spreader truck.
2. **Weigh the full bucket.** Record the weight in the table above. Then pour out the litter.
3. **Weigh the empty bucket.** Record the weight in the table above.
4. **Calculate the litter weight** by subtracting the weight of the empty bucket from the weight of the full bucket. Record the litter weight.
5. **Calculate the litter density** by multiplying the litter weight by 1.5. Record the litter density.
6. **Repeat steps 1 through 5** two more times. For reliable estimates, these procedures should be done for litter that comes from several places in the poultry house to approximate the average litter density. This is important because litter from different locations in the house can vary in density.
7. **Calculate the average litter density** by adding the three density values then dividing the result by 3.

Kart VanDevender, Ph.D., P.E., Extension Engineer, 12/2002

University of Arkansas, U.S. Department of Agriculture, and County Governments Cooperating

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Litter Calibration Worksheet

Truck: _____ _____ _____ _____ Date: _ __/_____ /__ __

To reduce math errors, fill in the blanks and do the math in order from left to right.

Tarp Area (ft^2) = Length (in) x Width (in) ÷ 144 (in^2/ft^2)

Tarp A Area = ____ in x _____in ÷ 144 (in^2/ft^2) = ___ft^2

Tarp B Area = _____in x _ _____in ÷ 144 (in^2/ft^2) = _____ ft^2

Litter Weight (lb) = Full Tarp Weight (lb) – Empty Tarp Weight (lb)

Tarp A Litter Weight = ___ lb – _____lb = _____lb

Tarp B Litter Weight = _____ lb – _____lb = __. ___lb

Rate (ton/acre) = Litter Weight (lb) x 43,560 (ft^2/acre) ÷ Tarp Area (ft^2) ÷ 2,000 (lb/ton)

Rate (ton/acre) = Litter Weight (lb) x 21.78 ÷ Tarp Area (ft^2)

Tarp A Rate = _____(lb) x 21.78 ÷ _____ (ft^2) = _____ ton/acre

Tarp B Rate = ____ (lb) x 21.78 ÷ _ (ft^2) = _____ ton/acre

Average Rate = _____ ton/acre

Layout Diagram and Comments

Target swath width = ft

Karl VanDevender, Ph.D., P.E., Extension Engineer, 12/2002

University of Arkansas, U.S. Department of Agriculture, and County Governments Cooperating

This publication was completed as part of an EPA 319(h) project. For the entire project, $259,087 was provided by the Environmental Protection Agency. The Cooperative Extension Service, University of Arkansas provided $195,452. The Arkansas Soil and Water Conservation Commission administered the federal funds.

DR. KARL VANDEVENDER and **GARY HUITINK** are Extension engineers with the University of Arkansas Cooperative Extension Service in Little Rock.

PSA1040-PD-1-08N

Appendix B

Animal Outputs

ANIMAL AND MANURE PRODUCTION

Poultry	Bldg #	# of Animals	Growout Weight	Production Length (weeks)	House Size (sq.ft.)	Litter Volume Annual Tons	N lbs/Yr per Ton	P2O5 lbs/Yr per Ton	K2O lbs/Yr per Ton
Breeders	1	10000	8	40	16000	120	42	62	42
Breeders	2	10000	8	40	16000	120	42	62	42
Breeders	3	10000	8	40	16000	120	42	62	42
Breeders	4	10000	8	40	16000	120	42	62	42

Nutrient content based on average values from University of Arkansas Agricultural Diagnostic Laboratory (1993 - 2000)

Appendix C

Revised Universal Soil Loss Equations
RUSLE 2
(for fields receiving litter allocations)

and

Hydrologic Conditions

USDA NRCS

RUSLE2 Worksheet Erosion Calculation Record

info:

Inputs:
Tract #: A1234
Owner name: Tia and Da Yang
Field name: South

Location: Oklahoma\Delaware County
Soil: SgD Britwater gravelly silt loam, 3 to 8 percent slopes\Britwater gravelly silt loam 100%
Slope length (horiz): 100 ft
Avg. slope steepness: 4.0 %

Outputs:

Management	*Contouring*	*Strips / barriers*	*Diversion/terrace, sediment basin*	*Soil loss erod. portion, t/ac/yr*	*Soil detachment, t/ac/yr*	*Cons. plan. soil loss, t/ac/yr*	*Sed delivery, t/ac/yr*
Warm season grass; not harvested	a. rows up-and-down hill	(none)	(none)	0.050	0.050	0.050	0.050

USDA NRCS

RUSLE2 Worksheet Erosion Calculation Record

Info:

Inputs:
Tract #: A1234
Owner name: Tia and Da Yang
Field name: 40 North

Location: Oklahoma\Delaware County
Soil: Sn Razort gravelly loam, 0 to 3 percent slopes, occasionally flooded\Razort gravelly loam 100%
Slope length (horiz): 100 ft
Avg. slope steepness: 3.0 %

Outputs:

Management	*Contouring*	*Strips / barriers*	*Diversion/terrace, sediment basin*	*Soil loss erod. portion, t/ac/yr*	*Soil detachment, t/ac/yr*	*Cons. plan. soil loss, t/ac/yr*	*Sed. delivery, t/ac/yr*
Warm season grass; not harvested	a. rows up-and-down hill	(none)	(none)	0.038	0.038	0.038	0.038

Yang-Da.pdf

ESWM 009145

PI-Fisher00024688

USDA NRCS

RUSLE2 Worksheet Erosion Calculation Record

Info:

Inputs:
Tract #: A1234
Owner name: Tia and Da Yang
Field name: Middle

Location: Oklahoma\Delaware County
Soil: SgD Britwater gravelly silt loam, 3 to 8 percent slopes\Britwater gravelly silt loam 100%
Slope length (horiz): 100 ft
Avg. slope steepness: 4.0 %

Outputs:

Management	*Contouring*	*Strips / barriers*	*Diversion/terrace, sediment basin*	*Soil loss erod. portion, t/ac/yr*	*Soil detachment, t/ac/yr*	*Cons. plan. soil loss, t/ac/yr*	*Sed. delivery, t/ac/yr*
Warm season grass; not harvested	a. rows up-and-down hill	(none)	(none)	0.050	0.050	0.050	0.050

USDA NRCS

RUSLE2 Worksheet Erosion Calculation Record

Info

Inputs:
Tract #: A1234
Owner name: Tia and Da Yang
Field name: West

Location: Oklahoma\Delaware County
Soil: CIE Clarksville stony silt loam, 5 to 20 percent slopes\Clarksville stony silt loam 100%
Slope length (horiz): 100 ft
Avg. slope steepness: 6.0 %

Outputs:

Management	*Contouring*	*Strips / barriers*	*Diversion/terrace, sediment basin*	*Soil loss erod. portion, t/ac/yr*	*Soil detachment, t/ac/yr*	*Cons. plan. soil loss, t/ac/yr*	*Sed. delivery, t/ac/yr*
Warm season grass; not harvested	a. rows up-and-down hill	(none)	(none)	0.064	0.064	0.064	0.064

Hydrologic conditions

In most cases, the hydrologic condition of the site affects the volume of runoff more than any other single factor. The hydrologic condition considers the effects of cover type and treatment on infiltration and runoff and is generally estimated from density of plant cover and residue on the ground surface. Good hydrologic condition indicates that the site usually has a lower runoff potential. Crop residue tilled into the soil and the residual root system from grasses that have been in crop rotations produce a good hydrologic condition. A grassland cover is good if the vegetation covers 75 percent or more of the ground surface and is lightly grazed. A cover is poor if vegetation covers less than 50 percent of the ground surface or is heavily grazed. Grass cover is evaluated on the basal area of the plant, whereas trees and shrubs are evaluated on the basis of canopy cover.

USDA SCS 1989 Engineering Field Handbook Chapter 2.2

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Acre)

CODE 590

DEFINITION

Managing the amount, source, placement, form and timing of the application of nutrients and soil amendments.

PURPOSES

- To budget and supply nutrients for plant production.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To minimize agricultural nonpoint source pollution of surface and ground water resources.
- To protect air quality by reducing nitrogen and/or particulate emissions to the atmosphere.
- To maintain or improve the physical, chemical and biological condition of soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied that impact natural resources.

CRITERIA

General Criteria Applicable to All Purposes

Plans for nutrient management shall comply with all applicable federal, state, and local laws and regulations.

Plans for nutrient management shall be developed in accordance with policy requirements of the NRCS General Manual Title 450, Part 401.03 (Technical Guides, Policy and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy), technical requirements of the NRCS Field Office Technical Guide (FOTG); procedures contained in the National Planning Procedures Handbook (NPPH), and the NRCS National Agronomy Manual (NAM) Section 503.

All NRCS employees who review or approve plans for nutrient management shall be certified through the Oklahoma Nutrient Management Course or a certification program acceptable to Oklahoma NRCS. Technical Service Providers (TSPs) and/or non-NRCS employees will be certified through either the above program or through the TechReg website: http://techreg.usda.gov/ when assisting with the implementation of federal conservation programs for which NRCS has national technical responsibility and that include nutrient management. (NRCS General Manual Title 190, Ecological Sciences, Part OK 402.03, Policy for certification)

Plans for nutrient management that are elements of a more comprehensive conservation plan shall recognize other requirements of the conservation plan and be compatible with its other requirements.

Soil Sampling and Laboratory Analysis (Testing)

Nutrient planning shall be based on current soil test results developed in accordance with Oklahoma State University's (OSU) guidance. A current soil test will be no older than three (3) years unless otherwise required by federal, state or local laws.

Soil samples shall be taken at least once every three (3) years for analysis or more often if the crop rotation changes.

Grass plantings done under the Oklahoma NRCS Conservation Practice Standards Pasture Planting (512) or Range Planting (550) shall have a current soil test analysis for nitrogen, phosphorus, potassium and pH. Nitrogen will be assumed to be zero (0) if the test is older than 60 days and additional nitrogen has not been applied. ***Tables 1, 2, 3, and 4*** provide detailed

NRCS OK
June 2004

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources conservation Service

guidance for determining fertilizer and amendment requirements for grass establishment.

All grass plantings done under the Oklahoma NRCS Critical Area Planting (342) standard and specification should have a soil test analysis performed. In lieu of a current soil test, a fertilizer mixture of 40-40-40 (N-P_2O_5-K_2O) lbs./ac will be recommended.

Soil samples shall be collected at the 0 to 6-inch depth. A minimum of 20 core samples shall be taken randomly from the field or sample area. The core samples shall be collected and mixed thoroughly in a clean plastic container. Approximately one (1) pint of the mixed core samples needs to be placed in a bag for testing along with an information sheet.

When the soil test nitrogen exceeds the recommended plant requirements (excessive) based on a realistic yield goal, a representative soil sample will be taken for the subsoil in addition to the 6-inch sample. This sample shall represent the soil layer from 7 to 24 inches in depth. The OSU County Extension Service Office is available to assist with the soil testing process. Additional information concerning soil sampling can be found in the **OSU Extension Fact Sheet F-2207, *How to Get a Good Soil Sample***.

If a soil test laboratory other than OSU is used, the lab shall use the same phosphorus and potassium extractant (Mehlich-3) used by the OSU lab and shall be based on the same requirements of those used at OSU. The soil testing laboratory shall be a member of the North American Proficiency Testing Program.

Soil testing shall include analysis for any nutrients for which specific information is needed to develop the nutrient plan, e.g. pH, nitrogen, phosphorus, and potassium. Additional information concerning soil test analysis can be found in the **OSU Extension Fact Sheet F-2225, *OSU Soil Test Interpretations and Fact Sheet F-2901, Procedures Used by OSU Soil, Water, and Forage Analytical Laboratory.***

Additional Criteria to Budget and Supply Nutrients for Plant Production

A nutrient budget for nitrogen, phosphorus, potassium, and pH shall consider all potential sources of nutrients including, but not limited to animal manure and organic by-products, wastewater, commercial fertilizer, starter fertilizers, crop residues, and legume credits. ***Exhibit 1*** is a worksheet for making nutrient budgets.

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June 2004

A nutrient budget will be required when a nutrient source is manure or other organic by-products, or the current soil test phosphorus index or nitrogen exceeds crop requirements based on OSU soil test analysis procedure. A nutrient budget will also be required when a field is located inside a watershed with a waterbody that has been identified as Nutrient Limited Waters (NLW) in Appendix A of the "Remarks" column of the Oklahoma Water Standards. The Water Resources Board's web site can be contacted for updated information concerning Nutrient Limited Waters of Oklahoma at www.state.ok.us/~owrb. Information regarding Nutrient Limited Waters is also available in the Oklahoma NRCS "Field Office Technical Guide, Section 1, Maps, OK Nutrient Limited Waters State Map". The web site is http://www.nrcs.usda.gov/technical/efotg/

Realistic yield goals shall be established using guidance in OSU's Extension Fact Sheet F-2225. A realistic yield goal is generally the highest yield achieved over the last 5 years. Rates of nutrient application established by OSU will be the basis for nutrient recommendations. For new crops or varieties, industry yield recommendations may be used until documented yield information is available.

Plans for nutrient management shall specify the form, source, amount, timing and method of application of nutrients on each field to achieve realistic production goals.

Erosion, runoff, and water management controls shall be installed, as needed, on fields that receive nutrients.

Inorganic Nutrient Application Rates

Nutrient application rates of inorganic sources of nutrients shall be based on recommendations that consider current soil test results, realistic yield goals and management capabilities. OSU nutrient recommendations for major crops are contained in ***Tables 1, 2, 3, and 4.***

Lime shall be applied, as needed, to adjust soil pH when the pH is below a crop's tolerance. Crop pH preferences are listed in ***Table 5.***

The following guidance shall also be used when applying inorganic sources of nutrients:

- **Nitrogen Application** - Nitrogen application rates shall match the required rates as closely as possible ***(Table 1).***
- **Phosphorus (P_2O_5) Application** - Phosphorus application rates shall match the required rates as closely as possible ***(Table 2).***

- **Potassium (K_2O) Application** - Excess potassium shall not be applied when it may cause unacceptable nutrient imbalances in crops or forages ***(Table 3)***.

- **Other Plant Nutrients** - The planned rates of application of secondary and micronutrients shall be consistent with **OSU guidance** ***(OSU Extension Fact Sheet F-2225)***.

- **Applications of nutrients below the recommended rates will be considered adequate if: *the applied rate is no more than 10% below or 10 pounds less, whichever is greater, than the recommended application rate.***

- **Available fertilizer blends make it difficult to apply fertilizer to meet specific recommendations. Also, the cost of purchasing fertilizer should discourage excess fertilizer application; *therefore*, reasonable nutrient applications above the recommended rates will be acceptable.**

- **Starter Fertilizers** - Starter fertilizers containing nitrogen, phosphorus and/or potassium may be applied to row crops to overcome early stress of the root environment such as a cool, wet soil. Starter fertilizers are applied in the row with the seed or banded along side the seed. In general, OSU guidance recommends no more than 30 lbs. of either nitrogen or K_2O per acre or in combination. No more than 90 lbs. per acre of P_2O_5 will be used in a starter fertilizer. These rates will vary with crop selection and climate conditions. The OSU County Extension Service Office is available for assistance in this area. The amount of starter fertilizer applied will be included in the nutrient budget.

- **Maintenance Fertilizers** - USDA Farm Programs such as the Conservation Reserve Program (CRP) require a periodic maintenance amount of fertilizer to maintain a stand of grass. In these long-term deferment programs the fertilizer maintenance recommendations for Nitrogen, Phosphorus, and Potassium are located in **Tables 1, 2, and 3 (page 17)**.

Nutrient Application Timing and Method

Timing and method of nutrient application shall correspond as closely as possible with plant nutrient uptake characteristics, cropping system limitations, weather and climatic conditions, and field accessibility.

Nutrients will not be applied to frozen, snow covered or saturated soil.

Nutrient applications associated with irrigation systems shall be applied in accordance with the requirements of Oklahoma Conservation Practice Standard Irrigation Water Management (449).

Additional Criteria to Properly Utilize Manure or Organic By-Products as a Plant Nutrient Source

Nutrient values of manure and organic by-products (excluding sewage sludge) shall be determined prior to land application based on laboratory analysis. The analysis shall include a minimum of moisture content, nitrogen, phosphorus, and potassium. Historic laboratory manure analysis values may be used in lieu of annual manure testing provided at least 2 years of manure testing history are available prior to application. The historic values must provide an accurate analysis of the material being applied. Manure analysis will be performed at least once every three years or sooner depending on federal, state or local laws. It is recommended that this be timed with soil testing procedures. Preliminary planning decisions may be based on "book values" acceptable to NRCS. Book values recognized by NRCS may be found in the **Agricultural Waste Management Field Handbook, Chapter 4 - Agricultural Waste Characteristics**. Actual application rates will be adjusted accordingly based on the current manure analysis.

Plant nutrient removal rates may be found in ***Table 7***. Crops not in Table 7 may be found in the ***Agricultural Waste Management Field Handbook, Chapter 6 – Role of Plants in Waste Management (Table 6-6)***.

Do not apply manure or organic by- products in the following situations as described in the Published County Soil Survey or Section II of the local NRCS Field Office Technical Guide:

- To areas within 100 feet of a perennial stream, pond, well, or sinkhole, unless an established buffer strip is present. The width of the buffer strip will be used as a set back distance for application purposes. The buffer strip must meet the requirements for design and maintenance established in the appropriate NRCS buffer standard and specification.

- To areas within 50 feet of an intermittent stream unless an established buffer strip is present. The width of the buffer strip will be used as a set back distance for application purposes. The buffer strip must meet the

requirements for design and maintenance established in the appropriate NRCS buffer standard and specification.

- To fields with > 15% slope.
- To soils less than 10 inches in depth to parent material.
- On soils that are frequently flooded.
- On soils that are frozen, snow covered, or water saturated.
- On soils where the rock fragments in the surface layer are 3 to 10 inches in diameter and exceed 50% by weight.
- On soils where the rock fragments in the soil surface layer are > 10" in diameter and exceed 25% by weight.
- On soils where the rock fragments are > 10 inches in diameter which covers > 3% of the soil surface and the slope is > 8%. (Soil map unit name will include the description of Extremely Stoney, Extremely Bouldery, or Extremely Rubbly or Very Rubbly)
- On areas eroding at levels greater than the soil loss tolerance, "T", from water erosion or active gullies unless following a conservation plan that will reduce erosion below "T". Use current Oklahoma NRCS soil loss prediction methods.
- On soils that are occasionally flooded. However, waste may be applied between June 20 and September 20 on soils classified as occasionally flooded. Manure may also be applied to soils classified as occasionally flooded between February 1 and April 20 if the area is established to cool season grasses 4 inches in height at the time of application.

Organic Nutrient Application Rates
The application rate for nutrients applied through irrigation shall not create runoff.

A nutrient budget shall be developed to account for all sources of nutrients.

Lime shall be applied, as needed, to adjust soil pH.

Application of material will be applied uniformly to the field.

The following shall also be used when applying manure or organic by-products:

- **Starter Fertilizers** - Starter fertilizers containing nitrogen, phosphorus and/or potassium may be applied to row crops to overcome early stress of the root environment such as a cool, wet soil. Starter fertilizers are applied in the row with the seed or banded along side the seed. OSU guidance recommends no more than 30 lbs of either nitrogen or K_2O per acre or in combination. No more than 90 lbs. per acre of P_2O_5 will be used in a starter fertilizer. These amounts are safe rates at which seed damage should not occur. The amount of starter fertilizer applied will be included in the nutrient budget.
- **Nitrogen Application** – Nitrogen application rates shall match the crop requirement as closely as possible. In some situations, additional nitrogen, from inorganic sources, may be required to supplement the organic sources. Manure maybe applied to a legume crop at a rate equal to the estimated nitrogen removal in the harvested plant biomass.
- **Phosphorus Application** – The maximum planned rates of phosphorus application shall be determined using the Oklahoma Phosphorus Assessment Worksheet ***(Tables 8, Table 9)***.

Field Risk Assessment
When manure or other organic by-products are applied, a field-specific assessment of the potential for phosphorus transport from the field shall be completed. This assessment shall be done using the Oklahoma Phosphorus Assessment ***(Table 8, Table 9)***.

The results of the assessment and recommendations shall be discussed with the producer and documented in the plan.

Heavy Metals Monitoring
When sewage sludge is applied, the accumulation of potential pollutants (including arsenic, cadium, copper, lead, mercury, selenium, and zinc) in the soils shall be monitored in accordance with the US Code, Reference 40CFR, Parts 403 and 503, and/or any applicable state and local laws or regulations. The role of monitoring the application of sewage or municipal sludge in Oklahoma is with the Oklahoma Department of Environmental Quality (DEQ). Contact DEQ for information concerning the use of municipal sludge.

Additional Criteria to Minimize Agricultural Non-point Source Pollution of Surface and Ground Water Resources

For water bodies in watersheds identified by the Oklahoma Water Resources Board as Nutrient Limited Waters (NLW) in Appendix A of the Oklahoma Water Standards, an assessment shall be completed for the potential transport of phosphorus when manure or organic by-products

are to be applied to a field. The Oklahoma Phosphorus Assessment will be used to make the assessment. The result of the assessment and recommendation shall be discussed with the producer and included in the plan.

Additional Criteria to Protect Air Quality by Reducing Nitrogen and/or Particulate Emissions to the Atmosphere

Incorporate surface applications of solid forms of manure or some commercial fertilizer nitrogen formulations (i.e., Urea) into the soil within 24 hours of application.

When applying liquid forms of manure with irrigation equipment select application conditions when there is high humidity, little/no wind, a forth coming rainfall event, and/or other conditions that will minimize volatilization losses into the atmosphere. The basis for applying manure under these conditions shall be documented in the nutrient management plan.

Handle and apply poultry litter or other dry types of animal manures when weather conditions are calm and there is less potential for blowing and emission of particulates into the atmosphere. The basis for applying manure under these conditions shall be documented in the nutrient management plan.

Additional Criteria to Improve the Physical, Chemical, and Biological Condition of the Soil

Manure or organic by-products incorporated into the soil will improve soil structure. Manure will be incorporated into the soil within 72 hours to reduce nutrient losses. The Oklahoma NRCS Conservation Practice Standard Crop Rotation (328) contains guidance for determining soil condition.

When non-legume crop yields exceed goals by more than 10%, or when a non-legume crop is terminated and returned to the soil as a green manure crop, additional nitrogen may be needed to supplement the nitrogen used by the soil microbes to breakdown the residue and avoid yield reductions.

Estimated nitrogen amounts needed per ton of crop residue are:

- Add 10 lbs. of nitrogen per ton of dry residue from non-legume crops.
- Add 5 lbs. of nitrogen per ton of non-legume green manure crop produced.

Most of the nitrogen legumes fix from the atmosphere is generally used for its own growth. Typical amounts of nitrogen remaining for the next crop are shown in ***Table 6.***

Soil pH will be adjusted to the optimum pH range for the crop.

Use of nutrient sources with high salt content will be minimized unless provisions are used to leach salts below the crop root zone.

Nutrients shall not be applied to flooded or saturated soils when the potential for soil compaction and creation of ruts is high.

CONSIDERATIONS

Avoid induced deficiencies of nutrients due to excessive levels of other nutrients.

Consider additional Oklahoma NRCS Conservation Practice Standards such as Conservation Cover (327), Grassed Waterway (412), Contour Buffer Strips (332), Filter Strip (393), Irrigation Water Management (449), Riparian Forest Buffer (391A), Conservation Crop Rotation (328), Cover Crop (340), and Residue Management (329A, 329B, or 329C, and 344) to improve soil nutrient and water storage, infiltration, aeration, tilth, diversity of soil organisms and to protect or improve water quality.

Consider cover crops whenever possible to utilize and recycle residual nitrogen.

Consider application methods and timing that reduce the risk of nutrients being transported to ground and surface waters, or into the atmosphere. These include:

- split applications of nitrogen to provide nutrients at the times of maximum crop utilization,
- avoid winter nitrogen application for spring seeded crops,
- band applications of phosphorus near the seed row,
- applying nutrient materials uniformly to application areas or as prescribed by precision agricultural techniques, and/or
- immediate incorporation of land applied manure or organic by-products,
- delaying field application of animal manures or other organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.

Consider minimum application setback distances from environmentally sensitive areas, such as sinkholes, wells, gullies, ditches, surface inlets or rapidly permeable soil areas.

NRCS OK
June 2004

Consider the potential problems from odors associated with the land application of animal manure, especially when applied near or upwind of residences.

Avoid nitrogen volatilization losses associated with the land application of animal manure. Volatilization losses can become significant, if manure is not immediately incorporated into the soil after application.

Consider the potential to affect National Register listed or eligible cultural resources.

Consider annual reviews to determine if changes in the nutrient budget are desirable (or needed) for the next planned crop.

On sites on which there are special environmental concerns, consider other sampling techniques. (For example: Soil profile sampling for nitrogen or surface sampling for phosphorus accumulation or pH changes.)

Consider ways to modify the chemistry of animal manure, including modification of the animal's diet to reduce the manure nutrient content, to enhance the producer's ability to manage manure effectively.

Consider using products or materials (e.g., nitrification inhibitors) that slow the conversion of nitrogen in manure or fertilizer into forms that move rapidly in the soil or into the atmosphere, and that reduce the potential for losses into water or air.

When applying manure with irrigation equipment, modification of the equipment can reduce the potential for volatilization of nitrogen from the time the manure leaves the application equipment until it reaches the surface of the soil (e.g. drop down tubes for center pivots). N volatilization from manure in a surface irrigation system will be reduced when applied under a crop canopy.

Consider the combined effects of nutrient application methods and other tillage operations on greenhouse gas emissions (e.g. nitrous oxide N_2O, carbon dioxide CO_2), and potential for carbon sequestration.

PLANS AND SPECIFICATIONS

Plans and specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s), using nutrients to achieve production goals and to prevent or minimize water quality impairment.

The following components shall be included in the nutrient management plan as applicable:

- aerial photograph or map and a soil map of the site,
- current and/or planned plant production sequence or crop rotation,
- results of soil, plant, water, manure or organic by-product sample analyses,
- realistic yield goals for the crops in the rotation,
- recommended nutrient rates, timing, form, and method of application and incorporation,
- location of designated sensitive areas or resources and the associated, nutrient management restriction,
- guidance for implementation, operation, maintenance, recordkeeping, and
- complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

If increases in soil phosphorus levels are expected, plans shall document:

- the soil phosphorus levels at which it may be desirable to convert to phosphorus based implementation,
- the relationship between soil phosphorus levels and potential for phosphorus transport from the field, and
- the potential for soil phosphorus drawdown from the production and harvesting of crops except as described in *General Criteria Applicable to All Purposes*.

When applicable, plans shall include other practices or management activities as determined by specific regulation, program requirements, or producer goals.

In addition to the requirements described above, plans for nutrient management shall also include:

- Discussion about the relationship between nitrogen and phosphorus transport and water quality impairment. The discussion about nitrogen should include information about nitrogen leaching into shallow ground water and potential health impacts. The discussion about phosphorus should include information about phosphorus accumulation in the soil, the increased potential for phosphorus transport in soluble form, and the types of water quality impairment that could result from phosphorus movement into surface water bodies.
- discussion about how the plan is intended to prevent the nutrients (nitrogen and

phosphorus) supplied for production purposes from contributing to water quality impairment.

- a statement that the plan was developed based on the requirements of the current standard and any applicable federal, state, or local regulations or policies; and that change in any of these requirements may necessitate a revision of the plan.
- the basis for the decisions for applying liquid or solid forms of manure with the intent of reducing nitrogen or particulate emissions to the atmosphere.

OPERATION AND MAINTENANCE

The owner/client is responsible for safe operation and maintenance of this practice including all equipment. The owner/client should consider addressing the following:

- Review plans periodically to determine if adjustments or modifications are needed. Changes in animal numbers, feed rations, crop rotations, storage facilities, and/or application timing or methods would be reasons for modifications to the nutrient management plan. Plans should be reviewed every three (3) years in conjunction with the soil test cycle or with applicable federal, state or local laws.
- Calibration of application equipment to ensure uniform distribution of material at planned rates.
- Protection of fertilizer, and/or organic by-products storage facilities from weather and accidental leakage or spillage.
- Documentation of the actual rate at which nutrients were applied. When the actual rates used differ from or exceed the recommended and planned rates, records will indicate the reasons for the differences.
- Records should be maintained to document plan implementation. As applicable, records should include:
  - soil test results and recommendations for nutrient application,
  - quantities, analyses and sources of nutrients applied,
  - dates and method of nutrient applications,
  - weather conditions at the time of application and time until a rainfall event occurred after application (applicable only to situations when air quality issues are being addressed in the plan)
  - crops planted, planting and harvest dates, yields, and crop residues removed,
  - results of water, manure, and organic by-product analyses, and
  - dates of review and person performing the review, and recommendations that resulted from the review.

Records should be maintained for five (5) years; or for a period longer than five years if required by other Federal, state, or local ordinances, or program or contract requirements.

Workers shall avoid unnecessary exposure to hazardous chemical fertilizers and/or organic by-products. Protection should include the use of protective clothing when working with plant nutrients. Extra caution must be taken when handling ammonia sources of nutrients, or when dealing with organic wastes stored in unventilated enclosures.

Material generated by cleaning nutrient application equipment should be disposed of according to state and local guidelines and regulations. Excess material should be collected and stored or field applied in an appropriate manner. Excess material should not be applied on areas of high potential risk for runoff and leaching.

NRCS OK
June 2004

SOIL TEST INTERPRETATIONS

Information contained in tables 1, 2, 3, 4, and 5 comes directly from Oklahoma State Universities Extension Fact Sheet, *F-2225, OSU Soil Test Interpretations, and the Oklahoma USDA Cost-Share Lime and Fertilizer Recommendations (May 2004).*

The information contained in the tables should be used in conjunction with current soil test analysis to prepare nutrient budgets and to develop nutrient management plans for land users.

Nutrient requirements for crops not listed on the following tables should be referred to the OSU Extension Agent or Specialist.

Oklahoma State Extension Fact Sheets are available on-line at the following web site:

http://osuextra.okstate.edu/siteindex.html

NRCS OK
June 2004

TABLE 1

Nitrogen Requirements

The nitrogen requirement is calculated by subtracting the soil test nitrogen value from the nitrogen required for a selected crop and yield goal.

	Wheat	Barley	Oats	Grain Sorghum		Corn		Cotton	
N Required lbs/ac	Yield Goal (bu/ac)			N Required lbs/ac	Yield Goal (lbs/ac)	N Required lbs/ac	Yield Goal (bu/ac)	N Required lbs/ac	Yield Goal (bales/ac)
30	15	20	25	30	2000	40	40	30	0.50
40	20	25	35	40	2500	50	50	45	0.75
60	30	35	55	50	3000	60	60	60	1.00
80	40	50	70	70	4000	85	85	75	1.25
100	50	60	90	85	4500	110	100	90	1.50
125	60	75	105	100	5000	130	120	105	1.75
155	70	90	125	160	7000	190	160	120	2.00
185	80	100	140	195	8000	215	180	135	2.25
240	100	125	175	230	9000	240	200	150	2.50
						300	250	165	3.00
						360	300	180	3.50

Cool Season Grasses (Fescue,Orchard,Ryegrass)		Established Weeping Lovegrass		Established Old World Bluestem		Established Bermudagrass	
N Required lbs/ac	Yield Goal (tons/ac)	N Required lbs/ac	Yield Goal (tons/ac)	N Required lbs/ac	Yield Goal (tons/ac)	N Required lbs/ac	Yield Goal (tons/ac)
60	1	35	1	35	1	50	1
120	2	70	2	70	2	100	2
180	3	110	3	110	3	150	3
240	4	160	4	150	4	200	4
300	5	220	5	200	5	260	5
						320	6
						400	7

NRCS OK
June 2004

TABLE 1 (Cont.)

Nitrogen Requirements

The nitrogen requirement is calculated by subtracting the soil test nitrogen value from the nitrogen required for a selected crop and yield goal.

Virgin Native Hay Meadow		Small Grains for Grazing		Forage Sorghum or Corn Silage		
N Required lbs/ac	Yield Goal (tons/ac)	N Required lbs/ac	Yield Goal (tons/ac)	N Required lbs/ac	Yield Goal	
					Silage tons/ac	Hay tons/ac
0	1.0	30	0.5	45	5	2.5
50	1.5	60	1.0	90	10	5.0
100	1.8	90	1.5	135	15	7.5
		120	2.0	185	20	10.0
		150	2.5	240	25	12.5
		180	3.0	300	30	15.0

Alfalfa	Peanuts	Soybeans	Mungbeans, Cowpeas, Guar
10 to 20 lbs/ac for establishment. None needed for maintenance	10 to 20 lbs/ac with P and K	10 to 20 lbs/ac with P and K	10 to 20 lbs/ac with P and K

NRCS OK
June 2004

TABLE 1 (Cont.)

Nitrogen Requirements

Nitrogen recommendations for grass establishments.

Soil Test N[1]	Native Grass / Bluestem Establishments	All Other Grass Establishments
	lbs/ac	
0	0	40
1	0	39
2	0	38
3	0	37
4	0	36
5	0	35
6	0	34
7	0	33
8	0	32
9	0	31
10	0	30
11	0	29
12	0	28
13	0	27
14	0	26
15	0	25
16	0	24
17	0	23
18	0	22
19	0	21
20	0	20[1]
21+	0	0

[1] Nitrogen soil test values are only valid if test is within the last 60 days; therefore assume nitrogen soil test of zero (0) when old tests are used. Nitrogen recommendations of less than 20 lbs/ac will not be made.

Note: For recommendations on maintenance of grass stands for long-term deferment programs (e.g. CRP) follow the guidance in Tables 1, 2, 3 on Page 17 of this standard.

NRCS OK
June 2004

TABLE 2

Phosphorus Requirements

P Soil Test Index	Small Grains		*Grain Sorghum*		Corn		Cotton	
	P_2O_5 lbs/ac	Percent Sufficiency	P_2O_5 lbs/ac	Percent Sufficiency	P_2O_5 lbs/ac	Percent Sufficiency	P_2O_5 lbs/ac	Percent Sufficiency
0	80	25	60	40	80	30	75	55
10	60	45	50	60	60	60	60	70
20	40	80	40	80	40	80	45	85
40	20	90	20	95	20	95	30	95
65+	0	100	0	100	0	100	0	100

P Soil Test Index	Established Cool Season Grasses		Established Weeping Lovegrass		Established Old World Bluestem		Established Bermudagrass	
	P_2O_5 lbs/ac	Percent Sufficiency	P_2O_5 lbs/ac	Percent Sufficiency	P_2O_5 lbs/ac	Percent Sufficiency	P_2O_5 lbs/ac	Percent Sufficiency
0	80	30	60	50	60	50	75	50
10	60	50	50	70	40	70	60	65
20	40	70	40	85	30	85	40	80
40	20	95	20	95	20	95	20	95
65+	0	100	0	100	0	100	0	100

P Soil Test Index	Small Grains for Grazing		Legumes in Pasture		Virgin Native Hay Meadows	
	P_2O_5 lbs/ac	Percent Sufficiency	P_2O_5 lbs/ac	Percent Sufficiency	P_2O_5 lbs/ac	Percent Sufficiency
0	80	25	75	50	40	50
10	60	45	60	65	20	80
20	40	80	40	80	0	95
40	20	90	20	95	0	100
65+	0	100	0	100	0	100

NRCS, OK
June 2004

TABLE 2 (Cont.)

Phosphorus Requirements

Phosphorus recommendations for grass establishments.

Phosphorus (P) Soil Test Index[1]	Bermudagrass Establishments	Fescue and Cool Season Grass Establishments	Bluestem and Lovegrass Establishments	Native Grass Establishments
	lbs/ac P_2O_5			
0	40	40	40	40
1	40	40	40	38
2	40	40	40	36
3	40	40	40	34
4	40	40	40	32
5	40	40	40	30
6	40	40	40	28
7	40	40	40	26
8	40	40	40	24
9	40	40	40	22
10	40	40	40	20[1]
11-20	40	40	30	0
21-40	30	30	20[1]	0
41-48	20[1]	20[1]	0	0
49+	0	0	0	0

[1] Phosphorus recommendations of less than 20 lbs/ac will not be made.

Note: For recommendations on maintenance of grass stands for long-term deferment programs (e.g. CRP) follow the guidance in Tables 1, 2, 3 on Page 17 of this standard.

P Soil Test Index	Alfalfa		Peanuts		Soybeans		Mungbean, Cowpeas, Guar	
	P_2O_5 lbs/ac	Percent Sufficiency	P_2O_5 lbs/ac	Percent Sufficiency	P_2O_5 lbs/ac	Percent Sufficiency	P_2O_5 lbs/ac	Percent Sufficiency
0	200	20	80	40	70	40	70	40
10	150	50	60	60	50	60	50	60
20	100	70	40	80	30	60	30	80
40	60	90	20	95	20	95	20	95
65+	0	100	0	100	0	100	0	100

NRCS OK
June 2004

TABLE 2 (Cont.)

Phosphorus Requirements

P Soil Test Index	Forage Sorghum or Corn Silage	
	P_2O_5 lbs/ac	Percent Sufficiency
0	100	30
10	75	60
20	45	80
40	25	95
65+	0	100

TABLE 3

Potassium Requirements

K Soil Test Index	Small Grains		Grain Sorghum		Corn		Cotton	
	K_2O lbs/ac	Percent Sufficiency	K_2O lbs/ac	Percent Sufficiency	K_2O lbs/ac	Percent Sufficiency	K_2O lbs/ac	Percent Sufficiency
0	60	50	100	40	120	40	110	40
75	50	70	75	65	80	60	80	60
125	40	80	50	80	60	75	60	75
200	20	95	30	95	40	90	40	90
250+	0	100	0	100	0	100	0	100

K Soil Test Index	Established Cool Season Grasses		Established Weeping Lovesgrass		Established Old World Bluestem		Established Bermudagrass	
	K_2O lbs/ac	Percent Sufficiency	K_2O lbs/ac	Percent Sufficiency	K_2O lbs/ac	Percent Sufficiency	K_2O lbs/ac	Percent Sufficiency
0	70	60	80	40	80	40	140	40
75	60	70	60	60	60	60	80	60
125	50	80	40	80	40	80	50	75
200	30	95	20	95	20	95	30	90
250+	0	100	0	100	0	100	0	100

NRCS OK
June 2004

TABLE 3 (Cont.)

Potassium Requirements

K Soil Test Index	Small Grains for Grazing		Legumes in Pasture		Virgin Native Hay Meadows	
	K_2O lbs/ac	Percent Sufficiency	K_2O lbs/ac	Percent Sufficiency	K_2O lbs/ac	Percent Sufficiency
0	60	50	80	50	40	40
75	50	70	60	65	30	70
125	40	80	40	80	20	85
200	20	95	20	95	0	95
250+	0	100	0	100	0	100

Potassium recommendations for grass establishments.

Potassium (K) Soil Test Index[1]	Bermudagrass Establishments	Fescue and Cool Season Grass Establishments	Bluestem and Lovegrass Establishments	Native Grass Establishments
	lbs/ac K_2O			
0-40	40	40	40	40
41-80	40	40	40	30
81-125	40	40	30	20[1]
126-200	30	30	20[1]	0
201-216	20[1]	20[1]	0	0
217+	0	0	0	0

[1] Potassium recommendations of less than 20 lbs/ac will not be made.

Note: For recommendations on maintenance of grass stands for long-term deferment programs (e.g. CRP) follow the guidance in Tables 1, 2, 3 on Page 17 of this standard.

K Soil Test Index	Alfalfa		Peanuts		Soybeans		Mungbeans, Cowpeas, Guar	
	K_2O lbs/ac	Percent Sufficiency	K_2O lbs/ac	Percent Sufficiency	K_2O lbs/ac	Percent Sufficiency	K_2O lbs/ac	Percent Sufficiency
0	280	20	80	40	100	40	80	50
75	210	50	60	60	70	60	60	60
125	140	70	40	75	60	75	45	80
200	80	90	30	90	40	90	30	90
250	40	100	0	100	0	100	0	100
350+	0	100	0	100	0	100	0	100

NRCS OK
June 2004

TABLE 3 (Cont.)

Potassium Requirements

K Soil Test Index	Forage Sorghum or Corn Silage	
	K_2O lbs/ac	Percent Sufficiency
0	180	40
75	130	60
125	90	75
200	60	90
250+	0	100

NRCS, OK
June 2004

Maintenance of Grasses in USDA Deferment Programs (e.g., CRP)

Table 1 (Cont.)
Nitrogen (N) Requirements

Soil Test N[1]	Stand Maintenance of All Grasses
	lbs/acre
0	40
1	39
2	38
3	37
4	36
5	35
6	34
7	33
8	32
9	31
10	30
11	29
12	28
13	27
14	26
15	25
16	24
17	23
18	22
19	21
20	20[1]
21+	0

[1]Nitrogen, Phosphorus, and Potassium recommendations less than 20 lbs/acre will not be made.

Table 2 (Cont.)
Phosphorus (P) Requirements

Phosphorus (P) Soil Test Index[1]	Native Grass Stand Maintenance	Bluestem and Lovegrass Stand Maintenance	Stand Maintenance of All Other Grasses
	lbs/acre P_2O_5		
0	40	40	40
1	38	40	40
2	36	40	40
3	34	40	40
4	32	40	40
5	30	40	40
6	28	40	40
7	26	40	40
8	24	40	40
9	22	40	40
10	20[1]	40	40
11-20	0	30	40
21-40	0	20[1]	30
41-48	0	0	20[1]
49+	0	0	0

Table 3 (Cont.)
Potassium (K) Requirements

Potassium (K) Soil Test Index[1]	Native Grass Stand Maintenance	Bluestem and Lovegrass Maintenance	Stand Maintenance for All Other Grasses
0-40	40	40	40
41-80	30	40	40
81-125	20[1]	30	40
126-200	0	20[1]	30
201-216	0	0	20[1]
217+	0	0	0

NRCS OK
June 2004

TABLE 4

Liming Requirements

Lime required to raise the soil pH to 6.8 for all crops and 5.5 for continuous wheat or for grass establishment

Soil Buffer Index	All Crops, Established Grasses, or Legumes except Continuous Wheat	*Continuous Wheat and New Seedlings of Grass (Establishment)
	**ECCE Lime (tons/ac)	**ECCE Lime (tons/ac)
6.0	5.2	1.4
6.1	4.7	1.2
6.2	4.2	1.0
6.3	3.7	0.9
6.4	3.1	0.8
6.5	2.5	0.6
6.6	1.9	*** 0.5
6.7	1.4	*** 0.5
6.8	1.2	*** 0.5
6.9	1.0	*** 0.5
7.0	0.7	*** 0.5
7.1	***0.5	*** 0.5
7.2	0.0	*** 0.5

** Lime will be required for establishment when the soil test pH is <4.5 for fescue and lovegrass and <5.0 for all other grasses.*

*** Effective Calcium Carbonate Equivalent - Pure calcium carbonate ground fine enough to be 100% effective. The rate of aglime to apply can be determined from the ECCE requirement using the following formula: Tons of aglime/ac = Tons ECCE lime required / %ECCE x 100.*

**** Lime applications at or below 0.5 tons per acre are recommended, but not required due to economics.*

NRCS OK
June 2004

TABLE 5

Crop pH Preference *

Crop	Preferred pH Range
Cowpeas, Mungbeans, Corn, Guar, Oats, Rye, Sorghum, Sudan, Wheat	5.5 – 7.0
Cotton	5.7 – 7.0
Soybeans, Peanuts,	5.8 – 7.0
Barley	6.5 – 7.0
Forages	**Preferred pH Ranges**
Bluestem, Native Hay, Fescue, Weeping Lovegrass	4.5 – 7.0
Vetch, Crimson Clover, Orchardgrass, Ryegrass	5.5 – 7.0
Bermudagrass	5.7 – 7.0
Alsike, Red and White (ladino) Clovers, Arrowleaf Clover	6.0 – 7.0
Alfalfa, Sweet Clover	6.2 – 7.5

*** Most legumes will tolerate a pH 0.5 units less and 1.0 units higher than indicated above, but production will be significantly reduced. Non-legumes tend to tolerate a pH 0.5 to 1.0 units less (but not less than 4.0) and 1.0 to 2.0 units higher that indicated above.**

NRCS OK
June 2004

TABLE 6

Nitrogen Credits

AVERAGE NITROGEN REMAINING AFTER LEGUME CROP

Legume	*Nitrogen remaining for next crop (Legume hayed or harvested) Lbs/ac	**Green manure crop nitrogen remaining (Legume unharvested) Lbs/ac
Alfalfa	80	200
Ladino Clover	60	180
Sweet Clover	60	120
Red Clover	40	115
White Clover	20	100
Soybeans	20	60
Cowpeas	30	90
Vetch	40	80
Lespedeza (annual)	20	85
Peas	40	70
Peanuts	20	40
Beans	20	40

** These numbers are derived from crops that are harvested and have the remaining crop residues returned to the soil by tillage. (Reference - Oklahoma Soil Fertility Handbook, 1997 Edition, pg. 21)*

*** A green manure crop is not harvested or grazed and is returned to the soil just prior to maturity. These numbers reflect the amount of nitrogen available for the next crop when the legume is used as a green manure crop. The numbers are adjusted to account for 30% nitrogen loss due to volatilization, leaching, and microbial action. (Reference – Soil Fertility and Fertilizers, Tidsdale and Nelson, pg. 128 and 566)*

NRCS, OK
June 2004

TABLE 7

Crop Nutrient Removal

% of Dry Material Harvested					
Crop		Weight/Unit	% N	% P	% K
Barley	grain	48 lbs/bu	1.82	0.34	0.43
	straw	72 lbs/bu	0.75	0.11	1.25
Corn	grain	56 lbs/bu	1.61	0.28	0.40
	stover	56 lbs/bu	1.11	0.20	1.34
Oats	grain	32 lbs/bu	1.95	0.34	0.49
	straw	64 lbs/bu	0.63	0.16	1.66
Rye	grain	56 lbs/bu	2.08	0.26	0.49
	straw	84 lbs/bu	0.50	0.12	0.69
Sorghum	grain	56 lbs/bu	1.67	0.36	0.42
	stover	56 lbs/bu	1.08	0.15	1.31
Soybeans	beans	60 lbs/bu	6.25	0.64	1.90
	stover	75 lbs/bu	2.25	0.22	1.04
Wheat	grain	60 lbs/bu	2.08	0.62	0.52
	straw	102 lbs/bu	0.67	0.07	0.97
Cotton	lint & seed	500 lbs/bale	2.67	0.58	0.83
	burs & stalks	3 lbs/lb of lint	1.75	0.22	0.83
% of Dry Material Harvested					
Forage Crop			% N	% P	% K
Alfalfa			2.25	0.22	1.87
Bermuda			1.88	0.19	1.40
Tall Fescue			1.97	0.20	2.00
Ryegrass			1.67	0.27	1.42
Wheatgrass			1.42	0.27	2.68
Dallisgrass			1.92	0.20	1.72
Native Hay			1.06	0.40	1.58
Clovers			2.00	0.22	1.66
Lespedeza			2.33	0.21	1.06

These crop nutrient removal figures come from the NRCS Agricultural Waste Management Field Handbook, Chapter 6, Role of Plants in Waste Management (Table 6-6). The handbook lists additional crops not listed above. These numbers represent average figures taken from multiple sources and are nutrients removed in the harvested portion of the crop. These figures can be used as guidance for waste management planning purposes. Actual waste application will be based on soil test.

NRCS OK
June 2004

Example calculation to estimate nutrients removed

Wheat:

Yield: 40 bu/ac 60 lbs/bu x 40 bu = 2400 lbs of grain

1 Ton straw baled and removed from field 1 ton x 2000 lbs = 2000 lbs of straw

Grain: 2400 lbs x 0.0208 (%N/lb) = 49.92 lbs Nitrogen in grain

2400 lbs x 0.0062 (%P/lb) = 14.88 lbs Phosphorus in grain

2400 lbs x 0.0052 (%K/lb) = 12.48 lbs Potassium in grain

Straw: 2000 lbs x 0.0067 (%N lb) = 13.40 lbs Nitrogen in straw

2000 lbs x 0.0007 (%P lb) = 1.40 lbs Phosphorus in straw

2000 lbs x 0.0097 (%K/lb) = 19.40 lbs Potassium in straw

Totals:	Nitrogen	Phosphorus	Potassium
Grain	42.92 lbs	14.88 lbs	12.48 lbs
Straw	13.40 lbs	1.40 lbs	19.40 lbs
	56 32 lbs N removed	16.28 lbs P removed	31.88 lbs K removed

Bermudagrass:

Yield: 4 ton/ac 4 ton/ac x 2000 lbs = 8000 lbs/ac

8000 lbs x 0.0188 (%N/lb) = 150.5 lbs Nitrogen in grass

8000 lbs x 0.0019 (%P lb) = 15.2 lbs Phosphorus in grass

8000 lbs x 0.0140 (% K/lb) = 112 lbs Potassium in grass

EXHIBIT 1 Nutrient Budget Worksheet

Landowner:	Field No.:	Acres

Purpose (Check all that apply)

- ☐ Budget and supply nutrients for plant production
- ☐ Minimize agricultural nonpoint source pollution
- ☐ Utilize organic material as nutrient source
- ☐ Maintain or improve soil condition

Crop Sequence/Rotation	Expected Yield

Nutrient Content of Manure per ton

N Test	N Remaining	P_2O_5	K_2O

Current Soil Test Levels

N	P	K	pH	SOM%	EC

Recommended Nutrients to Meet Expected Yield and Grass Establishment (See Tables in 590 Standard)

N	N for Grass Est.	P_2O_5	K2O	Lime	Other

Nutrient Sources

Credits	N	P_2O_5	K_2O
1. Nitrogen credits from previous legume crop			
2. Residual from long-term manure application			
3. Irrigation water			
4. Other (Atmosphere, etc.)			
5. Total Credits			

Applied Nutrients		N		P_2O_5		K_2O	
		Alt. 1	Alt. 2	Alt. 1	Alt. 2	Alt. 1	Alt. 2
6. Fertilizer	Starter						
	Other						
7. Manure or Organic by-products							
8. Total Applied Nutrients							
9. Total Nutrients (add lines 5 and 8 plus N from Soil Test)							
10. Recommended Nutrients							
11. Nutrient Status (subtract line 10 from 9)							

If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.
If line 11 is a positive number, this is the amount by which the applied nutrients exceed the crop requirements.

Nutrient Management Decision - Including method, rate, form and timing of application.	Producer Selected Alternative:

NRCS, OK
June 2004

590 – 24

OKLAHOMA PHOSPHORUS ASSESSMENT WORKSHEET

Client Name:		Field(s):		Date:	
Planner:		Location:		Crop:	
Nutrient Limited Watershed (yes/no):				Ctrl + C clears worksheet	

Site Characteristics

Soil Test P Index Mehlich III (lbs./ac)			
Application Method	Surface applied and incorporated within 7 days or injected 2" below the surface	Surface applied or incorporated more than 7 days after application	Surface applied on frozen or snow covered ground
Land Slope %	0 - 8 %	8.1 - 15 %	> 15.1 %

Transport Characteristics

Erosion Rate Greater Than "T"	No	Yes	
Flooding Frequency	None	Occasionally	Frequently
Distance of Manure Application to Perennial Stream, Pond, Well, or Sinkhole	> 100 ft. or Buffer Strip Established	0 - 100 ft.	
Distance of Manure Application to Intermittent Stream	> 50 ft. or Buffer Strip Established	0 - 50 ft.	
Soil Surface Loss Potential	Nominal	Intermediate	High
Depth of Soil	> 20.1 in.	10.1 - 20 in.	0 - 10 in.
Rock Fragments in Soil Surface 3" to 10 " in diameter and exceed 50% by weight or > 10" in diameter and exceed 25% by weight	No	Yes	
Rocks > 10" in diameter which cover > 3% of the Soil Surface	No	Yes	

Non - Nutrient Limited Watershed

Nutrient Limited Watershed

NRCS OK
June 2004

Table 8
Annual Waste Application Rates for Non-Nutrient Limited Watershed

Rating	Soil Test P Index	0 – 8% Slope	8 to 15% Slope	0 to 15% Slope
		Soil > 20" Deep	Soil > 20" Deep	Soil 10" to 20" Deep
*Low	0 – 65	Full Rate	Full Rate Split Application	Half Rate
*Moderate	66 – 250	Full Rate	Half Rate	Half Rate
*High	251 – 400	Half Rate	Half Rate	Half Rate
*Very High	> 400	Plant Removal	Plant Removal	Plant Removal
*Severe	*	No Application	No Application	No Application

Rating	Soil Test P Index	Rocks >10" in diameter which cover >3% of the soils surface and <8% slope
*Low	0 – 65	Half Rate
*Moderate	66 – 250	Half Rate
*High	251 – 400	Half Rate
*Very High	> 400	Plant Removal
*Severe	*	No Application

* See Severe Rating-No Application listed below. Check for specific site characteristics which may deem the field inadequate for manure application.

Waste Application Rates

Full Rate – Not to exceed the Nitrogen requirement of the crop and the following P_2O_5 rates:

1. 200 lbs P_2O_5 per acre when surface applied.
2. 300 lbs P_2O_5 per acre when application is by sprinkler irrigation and managed to prevent runoff from field.
3. 400 lbs P_2O_5 per acre if injected below the soil surface or surface applied and incorporated within 7 days.

Half Rate – Not to exceed the Nitrogen requirement of the crop and the following P_2O_5 rates:

1. 100 lbs P_2O_5 per acre when surface applied.
2. 150 lbs P_2O_5 per acre when application is by sprinkler irrigation and managed to prevent runoff from field.
3. 200 lbs P_2O_5 per acre if injected below the soil surface or surface applied and incorporated within 7 days.

Split Application – Not to exceed the Nitrogen requirement of the crop

Application will be no more than ½ the allowed P_2O_5 rate per application at least 30 days apart.

Severe Rating - No Application

NRCS OK
June 2004

Do not apply manure or organic by-products in the following situations. Reference the Published County Soil Survey or Section II of the local NRCS Field Office Technical Guide.

- To areas within 100 feet of a perennial stream, pond, well, or sinkhole, unless an established buffer is present. The width of the buffer will be used as a set back distance for application purposes. The buffer must meet the requirements for design and maintenance established in the NRCS buffer standard and specification.
- To areas within 50 feet of an intermittent stream unless an established buffer is present. The width of the buffer will be used as a set back distance for application purposes. The buffer must meet the requirements for design and maintenance established in the NRCS buffer standard and specification.
- To fields with > 15% slope.
- To soils with less than 10 inches in depth to parent material.
- On soils that are frequently flooded.
- On soils that are frozen, snow covered, or water saturated.
- On soils where the rock fragments in the surface layer are 3 to 10 inches in diameter and exceed 50% by weight.
- On soils where the rock fragments in the soil surface layer are > 10" in diameter and exceed 25% by weight.
- On soils where the rock fragments are > 10 inches in diameter which covers > 3% of the soil surface and the slope is > 8%.
- On areas eroding at levels greater than the soil loss tolerance, "T", from water erosion or active gullies unless following a conservation plan that will reduce erosion below "T". Use current Oklahoma NRCS erosion prediction methods.
- On soils that are occasionally flooded. However, waste may be applied between June 20 and September 20 on soils classified as occasionally flooded. Manure may also be applied to soils classified as occasionally flooded between February 1 and April 20 if the area is established to cool season grasses 4 inches in height at the time of application.

NRCS, OK
June 2004

Table 9
Annual Waste Application Rates for Nutrient Limited Watershed

Rating	Soil Test P Index	0 – 8% Slope	8 to 15% Slope	0 to 15% Slope
		Soil > 20" Deep	Soil > 20" Deep	Soil 10" to 20" Deep
*Low	0 – 65	Full Rate	Full Rate Split Application	Half Rate
*Moderate	66 – 120	Full Rate	Half Rate	Half Rate
*High	121 – 300	Half Rate	Half Rate	Half Rate
*Severe	> 300	No Application	No Application	No Application

Rating	Soil Test P Index	Rocks >10" in diameter which cover >3% of the soils surface and <8% slope
*Low	0 – 65	Half Rate
*Moderate	66 – 120	Half Rate
*High	121 – 300	Half Rate
*Severe	> 300	No Application

* See Severe Rating-No Application below. Check for specific site characteristics which may deem the field inadequate for manure application.

Waste Application Rates

Full Rate – Not to exceed the Nitrogen requirement of the crop and the following P_2O_5 rates:

1. 200 lbs P_2O_5 per acre when surface applied.
2. 300 lbs P_2O_5 per acre when application is by sprinkler irrigation and managed to prevent runoff from field.
3. 400 lbs P_2O_5 per acre if injected below the soil surface or surface applied and incorporated within 7 days.

Half Rate – Not to exceed the Nitrogen requirement of the crop and the following P_2O_5 rates:

1. 100 lbs P_2O_5 per acre when surface applied.
2. 150 lbs P_2O_5 per acre when application is by sprinkler irrigation and managed to prevent runoff from field.
3. 200 lbs P_2O_5 per acre if injected below the soil surface or surface applied and incorporated within 7 days.

Split Application – Not to exceed the Nitrogen requirement of the crop

Application will be no more than ½ the allowed P_2O_5 rate per application at least 30 days apart.

Severe Rating- No Application

NRCS, OK
June 2004

Do not apply manure or organic by-products in the following situations. Reference the Published County Soil Survey or Section II of the local NRCS Field Office Technical Guide.

- To areas within 100 feet of a perennial stream, pond, well, or sinkhole, unless an established buffer is present. The width of the buffer will be used as a set back distance for application purposes. The buffer must meet the requirements for design and maintenance established in the NRCS buffer standard and specification.
- To areas within 50 feet of an intermittent stream unless an established buffer is present. The width of the buffer will be used as a set back distance for application purposes. The buffer must meet the requirements for design and maintenance established in the NRCS buffer standard and specification.
- To fields with > 15% slope.
- To soils with less than 10 inches in depth to parent material.
- On soils that are frequently flooded.
- On soils that are frozen, snow covered, or water saturated.
- On soils where the rock fragments in the surface layer are 3 to 10 inches in diameter and exceed 50% by weight.
- On soils where the rock fragments in the soil surface layer are > 10" in diameter and exceed 25% by weight.
- On soils where the rock fragments are > 10 inches in diameter which covers > 3% of the soil surface and the slope is > 8%.
- On areas eroding at levels greater than the soil loss tolerance, "T", from water erosion or active gullies unless following a conservation plan that will reduce erosion below "T". Use current Oklahoma NRCS erosion prediction methods.
- On soils that are occasionally flooded. However, waste may be applied between June 20 and September 20 on soils classified as occasionally flooded. Manure may also be applied to soils classified as occasionally flooded between February 1 and April 20 if the area is established to cool season grasses 4 inches in height at the time of application.

NRCS, OK
June 2004

Appendix E

Previous year's application plans